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MORGAN (W. L.). **Control of Insect Pests of Tobacco. New Insecticides tested.**—*Agric. Gaz. N.S.W.* **60** pt. 10 pp. 536–538, 556, 1 ref. Sydney, 1949.

Owing to the desire to increase the amount of tobacco grown in New South Wales, investigations on improved methods of controlling insects that attack the crop were begun in 1948. The chief pests concerned [*cf. R.A.E.*, A **21** 553] are *Listroderes obliquus* Gylh., cutworms, *Plusia* sp., *Heliothis armigera* (Hb.), *Gnorimoschema operculella* (Zell.) and *G. heliopa* (Lower), and the treatment of the plants with a mixture of 1 lb. lead arsenate or 4 oz. paris green in 24 lb. pollard previously recommended [*cf. loc. cit.*] controls all but the last two, larvae of which mine in the leaves and stems and the stems, respectively. Since DDT had given good results against *G. operculella* in Queensland [*cf.* **36** 69] and is effective against other Lepidopterous larvae, a 1 per cent. DDT dust and a spray containing 0·05 per cent. DDT as an emulsified solution were applied to seed-beds at weekly intervals at rates of 0·75 lb. and 1 gal., respectively, per 300 sq. ft. and a 2 per cent. DDT dust and a similar spray containing 0·1 per cent. DDT were applied three times at fortnightly intervals at rates of 20 lb. and 25 gals., respectively, per acre to field crops, beginning two weeks after transplanting. Knapsack sprayers and dusters were used, and both dusting and spraying gave effective and about equal control of *Gnorimoschema* spp. In the field, one puff of dust was applied to each plant, and only the upper surfaces of the leaves were sprayed. At one place, where the soil was infested by nematodes, it was observed that plants that were cut back because they were injured by *G. heliopa* made weak regrowth and produced little or no foliage, while those that were not infested and so were not cut back gave satisfactory yields. The use of DDT in this district would probably enable tobacco to be grown there profitably despite the presence of nematodes if the soil were reconditioned by crop rotation, green manuring and proper irrigation.

The 1 per cent. DDT dust failed to protect seedlings that were attacked by large numbers of *L. obliquus* migrating from neighbouring weeds ; although the DDT killed the weevils, it did not do so rapidly enough to prevent feeding. Good control, however, was obtained by treating a wide strip round the seed-bed with the mixture of paris green and pollard. In young crops treated at fortnightly intervals, injury by *L. obliquus* and cutworms was negligible, but *Plusia* sp. and *H. armigera* caused some damage, which was less with the dust than the spray. Either treatment prevented serious injury, as leaves that were later harvested for curing had scarcely begun to develop, but both treatments were ineffective against *H. armigera* during the late stages of growth of the tobacco, mainly because the lower surfaces of the leaves were not treated. Thorough spraying or dusting would probably give control, but since it would be costly and probably result in a residue problem, frequent treatment with pollard mixtures is recommended. In comparative tests with these mixtures, DDT appeared to be more effective than lead arsenate, and as an alternative treatment for the control of *H. armigera*, mixtures of either 4 oz. 50 per cent. dispersible DDT powder or 2·5 lb. 5 per cent. DDT dust in 24 lb. pollard are suggested. They should be applied to the shoots after the spraying or dusting programme is completed.

Mature leaves collected 35 days after four applications of the field spray showed no DDT residues, and leaves from plants sprayed with 0·2 per cent. DDT and then given shoot treatment with 0·5 per cent. DDT in pollard three weeks before collection showed 1·4 parts DDT per million.

MORRIS (D. S.). **Oriental Peach Moth. Spraying Trials in the Goulburn Valley, 1949–50.**—*J. Dep. Agric. Vict.* **48** pt. 12 pp. 565–567, 1 graph. Melbourne, 1950.

Spray trials for the control of *Cydia molesta* (Busck) on peach in the Goulburn Valley of Victoria, which were begun in 1948–49, were continued in 1949–50

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on trees of a late-maturing variety that had been heavily infested in previous seasons. The sprays contained DDT, parathion (E605) or both, and they were applied on 28th November (mid-season), 28th December, 19th January and 10th February, or on the first or last three of these dates. The results were estimated from the percentages of fruits infested, and statistical analysis of them showed no significant difference in favour of any one of the date-schedules, indicating that a mid-season spray has little effect in reducing fruit infestation. This is in keeping with field observations that the larvae prefer tip growth to small immature peaches. The sprays, in order of apparent effectiveness, were 0·2 per cent. DDT, 0·1 per cent. DDT with and without 0·01 per cent. parathion, and 0·2 and 0·1 per cent. parathion. All gave significant control, and the differences between them were significant, except those between the three sprays containing DDT.

It is concluded from the two years' tests that DDT will protect the fruits effectively if applied at intervals of 3–4 weeks from the time when they become susceptible to infestation. Two applications should be adequate on mid-season varieties, but three or more may be required on late-maturing ones. The number depends on the course of adult emergence, and in these tests sprays were applied immediately after peaks of emergence as indicated by bait-pot catches. In 1949–50, there was a well-defined peak in early March, but progeny of this generation did not damage the fruits as they were harvested on 6th March. It was observed that many of the larvae had entered the fruits at the stem end, which is difficult to treat thoroughly. To give adequate cover, it was necessary to treat individual clusters of fruit, and it was advantageous to use a high-pressure spray with the flow directed upwards into the tree.

ROBERTSON (P. L.). **The Australian Carpet Beetle,** *Anthrenocerus australis* **(Hope), in New Zealand.**—*N.Z. J. Sci. Tech.* **31** (B) no. 1 pp. 1–15, 18 figs., 20 refs. Wellington, N.Z., 1950.

Dermestid larvae that differed from those of *Anthrenus verbasci* (L.), the common carpet beetle in New Zealand, were received from various places in both North and South Islands over a period of years, but proved difficult to rear in the laboratory. Some adults were eventually obtained, and identified as *Anthrenocerus australis* (Hope). This species, which is a serious pest in Australia [*R.A.E.*, A **33** 163], completes its development in one year when its diet includes some animal matter, such as fish meal, but when fed only on wool, as it was in the laboratory, it requires two years ; a further difficulty to be encountered in obtaining adults in the laboratory is that any that emerge and die before they are removed will probably be eaten by remaining larvae. Features of the larvae and characters distinguishing the adults and larvae from those of *Anthrenus verbasci* are described, keys for the differentiation in these stages of the genera *Anthrenocerus*, *Anthrenus*, *Attagenus* and *Trogoderma* are given, and the synonymy of *Anthrenocerus australis* is discussed ; it is possibly the species recently recorded by R. A. Harrison as *Attagenus* sp. [**38** 139].

During 1948, larvae were received from seven places in South Island, at one of which infestation was severe, and four in North Island. Wool, and textiles, clothing and other articles made of it, were attacked. A wide range of temperatures is tolerated, but a cool climate appears to be preferred. Measures suggested for control, in addition to some already noticed [**33** 163, etc.], include the application of a 5 per cent. DDT spray or a 10 per cent. dust beneath carpets and in cupboards and wardrobes where the deposit can be covered with paper, which, if made in summer when the beetles are active, should give protection until the following season, and fumigation of infested materials in sealed trunks by means

of chloropicrin applied on a piece of sacking at the rate of 0·5–1 oz. per 24 cu. ft. space, with an exposure of 24 hours.

Service and Regulatory Announcements, January–June 1950.—*S.R.A., B.E.P.Q.* nos. 176–177 pp. 1–32, 33–71. [Washington, D.C.] U.S. Dep. Agric., 1950.

An announcement relating to the Fruit and Vegetable Quarantine (no. 56) contains Administrative Instructions (B.E.P.Q. 587) (pp. 5–6) authorising the entry into the United States under permit from foreign countries of fruit and vegetables that have been treated by initial freezing at subzero temperatures and subsequently stored at temperatures not exceeding 0°F. with a storage tolerance of plus 20°F., provided that they are still adequately frozen on arrival in the United States and are not liable to attack in the country of origin by pests that are considered not to be destroyed by such freezing. This treatment is also authorised for fruit and vegetables imported from Hawaii and Porto Rico in Administrative Instructions (B.E.P.Q. 585 & 586) (pp. 8–9, 15–16) relating, respectively, to the Hawaiian and Puerto Rican Fruit and Vegetable Quarantines (nos. 13 & 58) ; in both cases the produce must be accompanied by a certificate from the country of origin. Further Announcements relating to the Hawaiian Fruit and Vegetable Quarantine (pp. 35–36) include an amendment to the supplemental regulations [*cf. R.A.E.*, A **39** 156], requiring pineapples to be subjected to an approved treatment before they are moved interstate from Hawaii, and Administrative Instructions (B.E.P.Q. 589) authorising fumigation with methyl bromide under supervision as such a treatment. It is to be carried out in approved atmospheric fumigation vaults at a dosage of 2 lb. methyl bromide per 1,000 cu. ft. space, including the load, for an exposure period of six hours, and the fumigated pineapples must be safeguarded against reinfestation prior to shipment.

Announcements relating to the domestic quarantine (Quarantine no. 52) against the pink bollworm [*Platyedra gossypiella* (Saund.)] in the United States include Administrative Instructions (B.E.P.Q. 558, third revision) (pp. 14–15) authorising fumigation with methyl bromide after loading as an alternative treatment for cottonseed that is produced in specified counties in the lightly infested area and is to be moved interstate [*cf.* **33** 286 ; **37** 376]. The treatment is to be carried out under supervision in approved road or railway vans constructed entirely of metal or with closely fitting wooden floors and with single doors not exceeding 7 ft. in width. Wooden floors are to be covered with sisalkraft paper and doors and other apertures sealed with approved materials during treatment, and there must be a 2 ft. air space above the seed. A duct system equipped with a blower, specifications for which are given, withdraws air from beneath the seed through a paper grain door in the aperture of the van door and returns it to the space above the seed. The methyl bromide is to be introduced as a gas into the return duct and volatilised in an approved manner as it is introduced into the van. The required dosage per 1,000 cu. ft. space is 7 lb. at seed temperatures of 60°F. and above or 8 lb. at seed temperatures below 60°F. ; the exposure period is to be 24 hours.

Other information includes summaries of plant-quarantine restrictions in Peru (pp. 20–25), Sweden (pp. 25–28), Egypt (pp. 53–59), Israel (pp. 61–63) and the Philippines (pp. 63–67), and supplements to summaries of restrictions already noticed in France (p. 19) [*cf.* **39** 157, etc.], India (pp. 19–20, 60) [**39** 157, etc.] and the United Kingdom (pp. 59–60) [**38** 53].

De Lotto (G.). **Gli insetti dannosi alle piante coltivate e spontanee dell' Eritrea. Nota 1. Elenco delle specie riscontrate fino al 1946.** [The Insects injurious to cultivated and wild Plants in Eritrea. Note 1. List of Species found up to 1946.]—*Boll. Soc. ital. Med. (Sez. Eritrea)* **7** no. 5–6 pp. 573–584, 20 refs. Asmara, 1947. **2. Elenco delle specie riscontrate nel 1947.** [2. List of Species found in 1947.]—*Op. cit.* **8** no. 1–2 pp. 84–90, 1 ref. 1948. **3. Elenco delle specie riscontrate nel 1948.** [3. List of Species found in 1948.]—*Op. cit.* **9** no. 1 pp. 112–118, 2 refs. 1949.

The insects cited in these lists are arranged under the plants attacked, and their distribution in Eritrea is briefly indicated. Corrections to a few of the records included in the first part are appended to the third.

Remaudière (G.). **Sur l'existence en France d'une nouvelle sous-espèce de *Locusta migratoria* L.**—*C.R. Acad. Sci.* **225** no. 21 pp. 1025–1026, 6 refs. Paris, 1947. **Sur la résistance des oeufs de *Locusta migratoria* L. ssp. *gallica* Rem. (phase grégaire) au froid et à l'immersion.**—*Rev. Path. vég.* **27** fasc. 1 pp. 25–34, 7 refs. Paris, 1948.

In the first of these papers, biometric data are given for solitary and gregarious adults of *Locusta migratoria* (L.) taken in 1945–47 during the outbreak in south-western France [*cf. R.A.E.*, A **34** 34 ; **35** 377 ; **37** 366]. These locusts are shown to differ from all the known subspecies of *L. migratoria*, and the name subsp. *gallica*, n., is proposed for them. In the solitary phase, they are found in sunlit parts of the forest zone of Landes (at the edges of roads, lakes and ponds, on sand dunes and in clearings and young pine plantations). Individuals in the gregarious phase appeared in this region in 1945 and migrated for more than 300 miles in 1946 and 1947, reaching the south coast of England [**37** 366] and the Mediterranean coast of France. *L. m. gallica* has one generation a year in both the solitary and gregarious phases.

In the second paper, the author points out that since *L. m. gallica* passes more than six months in the egg-stage, the resistance of the eggs to climatic conditions is of importance. The greater part of the burnt areas in which the locusts developed [*cf.* **35** 377] had been flooded for several months each winter before 1941, but the rainfall from November to March was scarcely 60–70 per cent. of the average in 1942–44, and it was in these years that the first swarms must have formed. In the winter of 1944–45, however, rainfall exceeded the average by 15 per cent. and flooded the lowlands, but large-scale hatchings occurred in spring, and the rainfall was 25 per cent. above the average in the winter of 1946–47, but the outbreak in spring was greater than ever. On 28th June 1946, egg-pods, from which the eggs hatched three to four days after they were collected, were found at the bottom of a damp ditch, whereas eggs laid about three feet above these had hatched during the first half of May. The ditch had contained an abundant flow of water from the end of December to the beginning of March, when it had dried up, and was filled again in late March and April, after which water remained lying in it until mid-June. The eggs had therefore survived two periods of submersion, and development almost to hatching had continued under water. The eggs of *L. migratoria* also survive temperatures below freezing point, as is indicated by the geographical distribution of the species, which includes central Russia and the high altitudes of Tibet.

In view of these facts and of divergent opinions in the literature on the effect of immersion, which are reviewed, laboratory experiments were carried out on the effects of cold and immersion on eggs of *L. m. gallica* during various stages of their development. All tests were carried out on egg-pods that had been laid by locusts in the gregarious phase in the Gironde in the autumn of

1946. Preliminary observations in nature showed that immediately after the egg had been laid, the embryo developed rapidly for about a week, after which development ceased until April. It was resumed when the spring temperatures became high enough, and blastokinesis then took place, the eggs hatching 2–4 weeks later. When eggs that had overwintered in the field were transferred to moist sand at a constant temperature of 30°C. [86°F.], blastokinesis began after two days and hatching occurred after 10–13 days. Eggs that were incubated under similar conditions immediately after they had been laid did not hatch but remained living for five or six months, development being arrested in the stage prior to blastokinesis. Similarly, 99 per cent. of eggs laid in September and transferred to 30°C. in October or November failed to hatch. These facts indicated that there is a true diapause. In January and February, eggs collected in the field and eggs kept in the laboratory at 10–20°C. [50–68°F.] since they had been laid hatched 12 days after transfer to 30°C., so that the diapause had been completed by that time and development could be resumed.

In the experiments on cold, eggs in diapause were collected in the field in October 1946 and kept at 30°C. until March 1947, during which time none had hatched. When half of these were then exposed to −7°C. [19·4°F.] for 48 hours and subsequently returned to 30°C., 20 per cent. hatched after five weeks and the others remained in diapause, as did untreated eggs ; after a further two months at 30–35°C. [86–95°F.], the embryos had developed but blastokinesis had not taken place. Intense cold thus resulted in a partial break of the diapause, but the resumption of development was very slow, since hatching took place three weeks after that of eggs kept at laboratory temperature. Several series of eggs alone or in egg-pods in the stage between the end of diapause and blastokinesis survived exposure for up to 15 days at −7 to −9°C. [19·4–15·8°F.], and all hatched within the normal period (13 days) at 30°C. When the eggs were exposed to −20°C. [−4°F.] for 24 hours and then incubated, about 50 per cent. survived ; these hatched at the same time as untreated eggs. Eggs exposed to −7°C. for three days when blastokinesis had begun suffered only 50 per cent. mortality, but eggs in which blastokinesis had been completed were all killed by exposure for seven days. When, however, an egg-pod was exposed for five days to −7°C. after two-thirds of the eggs had just hatched, the newly hatched insects were killed but the eggs were not. Of nymphs that were 1–2 days old when exposed to similar refrigeration, 30 per cent. survived.

In the experiments on immersion, isolated eggs and entire egg-pods gave identical results. In the first series, immersion was in water at 10–20°C. [50–68°F.]. When this took place 24 hours after the eggs had been laid, all died, the vitellus coagulating after a few days, so that in subsequent tests, the eggs were not immersed until they were at least eight days old. Diapausing eggs immersed from 12th October 1946 to 29th January 1947 and then transferred to moist sand at 30°C. all hatched 22 days later, while untreated eggs that had been kept at 10–12°C. [50–53·6°F.] hatched 13–14 days after transfer, having completed their diapause by 29th January. When immersion was continued until 8th May, no development had occurred, though untreated eggs were ready to hatch, but when treated eggs were incubated at 34°C. [93·2°F.], they hatched ten days later, which indicated that diapause had been terminated. Eggs in the stage between the end of diapause and blastokinesis that were immersed in March 1947 showed no further development by November, but when transferred to 30°C., they hatched in 12 days. In the second series, immersion was at 30–35°C. Two of three egg-pods in which the eggs were in the stage between the end of diapause and blastokinesis when they were immersed showed no sign of development after 60 days, but blastokinesis had begun in some of the eggs in the third pod after seven days and hatching took place in the water after 20 days, although the larvae died as soon as the chorion

had split. The remainder of the eggs in this pod were still in the same stage as those in the two others. Untreated eggs exposed to 30–35°C. on moist sand hatched after 12–13 days. Eggs immersed for ten days after blastokinesis had begun or was completed hatched 12–13 days later (controls hatching in 4–6 days), but when immersion was continued for 28–32 days, the process of hatching began in the water but was not completed.

LAPORTE (M. L.). **Hôtes nouveaux d'***Aspidiotiphagus citrinus* **How. (Hym. Chalcididae), parasite de cochenilles en Algérie.**—*Rev. Path. vég.* **27** fasc. 1 pp. 35–37, 3 refs. Paris, 1948.

The author gives a list of the Coccids that have been recorded as hosts of *Aspidiotiphagus citrinus* (Craw) in the western Mediterranean area and states that it was reared from *Chrysomphalus ficus* Ashm., *Pinnaspis aspidistrae* (Sign.), *Lepidosaphes beckii* (Newm.) (*citricola* (Pack.)) and *Parlatoria ziziphus* (Lucas) in Algeria during 1947. In the case of *L. beckii*, very young females and males on *Citrus* were parasitised, but not adult females. The percentage parasitism of *L. beckii* and *P. ziziphus* averaged 25 and ranged up to 50, which was all the more important since the only natural enemies of these Coccids previously observed in Algeria were Coccinellids.

REMAUDIÈRE (G.). **Éthologie de** *Gastroidea viridula* **De Geer (Col. Chrysomelidae).**—*Rev. Path. vég.* **27** fasc. 1 pp. 38–53, 11 figs., 14 refs. Paris, 1948.

A detailed account is given of observations in the laboratory in 1945 on the life-history of *Gastrophysa* (*Gastroidea*) *viridula* (Deg.), which is common on cultivated sorrel (*Rumex acetosa*), and occasionally causes appreciable injury to it, both larvae and adults feeding on the leaves. The rearing was begun with overwintered adults collected in northern France in April and continued until early September, by which time four overlapping generations had been completed, and larvae of the fifth were in the third (final) instar. The process of oviposition is described at considerable length ; in the field, the eggs are always laid in batches on the under-surfaces of the leaves. Females laid 100–744 eggs each, and the number per batch was usually about 40. The egg and pupal stages both lasted about 7, 5, and 4 days at 19–20°C. [66·2–68°F.], 22–23°C. [71·6–73·4°F.] and 25–26°C. [77–78·8°F.], respectively, and the larvae completed their development in about ten days. Pupation took place in the soil, and the newly emerged adults remained in it for 2–3 days. Pairing was first observed after 5–6 days, and oviposition after 7–10 days. Development in the field is retarded owing to the drop in the night temperatures, and the number of generations in a year appears to be governed by soil humidity ; summer drought prevented the emergence of adults of the second or third generation in the Bordeaux area in 1945, so that none was found on sorrel in August.

G. viridula also completed its development on *Rumex crispus* and *Polygonum aviculare*, but attempts to rear it on rhubarb (*Rheum officinale*) failed [*cf. R.A.E.*, A **15** 203], as the newly-hatched larvae were unable to perforate the thick cuticle of the leaves. When the cuticle was removed, the larvae fed for a day or two but soon died.

BALACHOWSKY (A.). **Sur le statut et la biologie de** *Quadraspidiotus ostreaeformis* **Curtis et de** *Quadraspidiotus pyri* **Licht., cochenilles nuisibles aux cultures fruitières.**—*Rev. Path. vég.* **27** fasc. 2 pp. 89–97, 2 pls., 17 refs. Paris, 1948.

As *Quadraspidiotus* (*Aspidiotus*) *pyri* (Licht.) and *Q. ostreaeformis* (Curt.), which are serious pests of fruit trees in the Palaearctic region, often occur on

the same species of plants in the same localities and have constantly been confused, the author gives characters of the adult females by which they can be distinguished. He then reviews records of their distribution and food-plants and gives lists, arranged by countries, of those that have been confirmed.

HOFFMANN (A.). **Un Curculionide nouveau nuisible aux oeillets cultivés.**—*Rev. Path. vég.* **27** fasc. 2 pp. 102–109, 2 pls., 1 ref. Paris, 1948.

Descriptions are given of the larva and the adults of both sexes of *Lixus remaudieri*, sp.n., a weevil that caused considerable losses of cultivated carnations in a plantation in Bouches-du-Rhône, France, in 1946 and 1947, together with characters distinguishing it from *L. sanguineus* (Rossi), with which it may have been confused. Although oviposition was not observed, it must occur over a period of several weeks, as very young larvae, full-fed larvae and pupae were found together on 9th July 1947. The larvae fed in the root-collar, a little below the soil surface, causing the plants to wither. Pupation occurred in the plants, and the adults emerged from the beginning of August to mid-September and probably overwintered. Infestation was confined to first-year plants, probably because their stems had not yet become woody. Infested plants should be removed and burnt, as it was found that when they were gathered and placed in a heap, the larvae continued to develop in them for several weeks and some adults emerged.

RUNGS (C.) & SCHAEFER (L.). **Un nouvel ennemi du pommier cultivé au Maroc.**—*Rev. Path. vég.* **27** fasc. 3 pp. 121–124, 1 fig. Paris, 1948.

Descriptions are given of the adults of both sexes of *Agrilus malicola*, sp.n., a Buprestid that was found attacking apple at Azrou, Morocco, in 1946. Infested twigs and branches were taken to the laboratory for examination, and several adults emerged between mid-June and the end of July in 1946 and a few at the same time in 1948. The trees attacked appeared relatively healthy but were growing in poorly drained soil. The eggs were laid singly near the terminal bud of a first- or second-year shoot, and the larvae tunnelled into the pith and down through the older branches pupating beneath the bark of a large branch or the trunk. The duration of the life-cycle is probably one year or perhaps two. Similar galleries were observed in apple twigs from the district of Meknès ; they contained *Agrilus* larvae, but the species could not be identified.

LEPESME (P.). **Note préliminaire sur la faune entomologique du** *Ficus thonningii* **Bl. en Haute-Volta.**—*Rev. Path. vég.* **27** fasc. 3 pp. 143–146, 2 figs., 3 refs. Paris, 1948.

Ficus thonningii, which is widely used as an ornamental tree in French West Africa, is attacked by numerous insects. Notes are given on those found in the north-east of the Ivory Coast in 1946–47. The only ones that caused serious damage were the Lymantriid, *Naroma signifera* Wlk., which defoliated the trees, and the Lamiids, *Phryneta aurocincta* (Gory) and *Petrognatha gigas* (F.), which bored in the trunks and branches. All three were common, but only the last was capable of killing the tree.

REMAUDIÈRE (G.). **Contribution à l'étude des** *Locusta migratoria* **L. phase** *solitaria* **de la région de Palavas (Hérault) (1re partie).**—*Rev. Path. vég.* **27** fasc. 3 pp. 147–163, 3 maps, 2 graphs, 21 refs. Paris, 1948.

Observations on *Locusta migratoria* (L.) in phase *solitaria* on the south coast of France in 1946–47 showed that the locusts could be divided into three well-defined size groups. Those with the smallest dimensions agreed with the

published data for examples of *L. migratoria* from Italy, France and Algeria considered by Waloff to constitute a Mediterranean race [*R.A.E.*, A **29** 323], and since examination of the specimens from Piedmont that Capra considered to represent an Italian race, designated by him race *cinerascens* (F.), showed that they also agreed with Waloff's measurements, all these locusts are considered to represent a distinct subspecies of *L. migratoria*, for which the name *cinerascens* is retained. Locusts of this subspecies were found in the coastal districts of the departments of Alpes-Maritimes, Var and Pyrénées-Orientales. The second group consisted of a population of which 90 per cent. of the individuals were considerably larger than these. They occurred along the narrow strip of coast enclosing the lagoons between Carnon and Cap d'Agde in Hérault, and since these locusts were most abundant near Palavas, they are referred to as Palavas locusts. The third group consisted of locusts of an intermediate size, taken near Hyères (Var), Fos-sur-mer (Bouches-du-Rhône), Valras (Hérault) and two places in Aude.

The main part of the paper consists of a discussion of the biometrical characters and the possible origin of the Palavas locusts. Both brown and green individuals were observed, green predominating, but there were no important biometrical differences between them. It was not altogether easy to compare them with the known subspecies of *L. migratoria*, since many of these have been defined on the basis of examples in phase *gregaria*. As phase *solitaria* is to be regarded as the normal form of the species, a comparison of the subspecies based on it would be instructive. Graphs are given indicating the frequency distribution of elytral lengths in males and females of the Palavas locusts and solitaries of the European subspecies of *L. migratoria* (*gallica* Rem. [*cf.* **39** 224], *rossica* Uv. & Zol., *cinerascens* and typical *migratoria*), and it is shown from these and consideration of other biometrical characters that the Palavas locusts differed clearly from all but typical *migratoria*. They also differed from subspecies *manilensis* (Meyen) of the Far East and *capito* (Sauss.), but comparison with data for subspecies *migratorioides* (R. & F.) from Africa was inconclusive since this subspecies is polymorphic in phase *solitaria* and evidently not homogeneous, its elytral length sometimes reaching that of the typical *migratoria*.

Locusts of the Palavas type have been taken at Palavas since 1886 and this locality is far from the classic migration routes of the typical *L. migratoria*, the most southerly of which is up the Danube valley, so that they might be indigenous in the locality. However, examples apparently of the typical subspecies were taken at Mont Stoû, in Carniola, in 1902 and 1907, and a female resembling the Palavas locusts was taken in Venice in 1938, though adults captured there in 1930 belonged to subsp. *cinerascens*. There is thus probably a still more southerly migration route of the typical subspecies up the Sava and the Drava valleys, and some of the locusts moving along it may at some time have penetrated as far as southern France, though there are no records of swarms having ever done so. The Palavas locusts would then be the descendants of these and belong to subsp. *migratoria*. A table is included showing biometrical data for the Palavas locusts as a whole, examples taken in different years, and green and brown examples of them separately, subspp. *cinerascens* and *gallica*, and the examples taken in Carniola and Venice.

MARTIN (H[enri]). **Contribution à l'étude du Balanin des noisettes** (*Balaninus nucum* **L.**).—*Rev. Path. vég.* **28** fasc. 1 pp. 3–28, 16 figs., 4 graphs, 1 map, 8 refs. Paris, 1949. (With a Summary in Spanish.)

The following is largely based on the author's summary of this account of observations in 1946–48 on the bionomics and control of *Curculio* (*Balaninus*) *nucum* L., in Tarragona, Spain, where this weevil is a serious pest of cultivated

hazel [*Corylus avellana*] [*cf. R.A.E.*, A **17** 17]. The overwintered adults first appeared at the end of March and emerged in numbers in the second half of April, but as the hazel-nuts were then too young, they fed on various fruits (including persimmon, pear and peach) and migrated to the nuts in May or the beginning of June. Pairing and oviposition began at the end of May, and maximum oviposition occurred in mid-June on early varieties of hazel and at the end of June on later ones. The larvae in the nuts became full-fed on the average about 40 days after oviposition and entered the soil under the trees to depths of 0·75–10 ins. All the larvae passed the first winter in the soil, and in the following June some pupated and gave rise to adults, which again overwintered. The other larvae remained in the soil for a second or third winter, so that the life-cycle of *C. nucum* lasts 2–4 years [*cf.* **29** 376 ; **33** 382 ; **35** 284]. Pupation always occurred in June, and the pupal stage was very short. When the development of the nuts was retarded by cold or damp, damage was more severe. The injury caused by the feeding punctures of the adults varied considerably from year to year, but it was always more severe than that caused by the oviposition punctures.

Experiments showed that the adults were extremely resistant to insecticides and that the first symptoms of paralysis appeared only after several hours of contact with DDT. When the weevils were placed under a sleeve on treated hazel branches, the best results were obtained with an emulsified solution of DDT, which gave 60–100 per cent. mortality after five days, whereas calcium arsenate, which appeared repellent, gave hardly any. In large-scale field trials, DDT gave 42–87 per cent. control when applied in emulsified solution, but was unsatisfactory in dusts and suspensions. Treatment of the soil with a dust or suspension of benzene hexachloride against the overwintering larvae was also ineffective. DDT should be applied in April to fruit trees and early varieties of hazel and in May or June to the later varieties, as soon as the overwintered weevils appear on them.

PERRET (J. E.) & BERGER (G.). **Observations et remarques sur** *Capnodis tenebrionis* **L. (Col. Buprestidae) au Maroc.**—*Rev. Path. vég.* **28** fasc. 1 pp. 54–65, 2 figs., 9 refs. Paris, 1949.

Observations on the bionomics of *Capnodis tenebrionis* (L.) on stone-fruit trees in Morocco [*cf. R.A.E.*, A **31** 182] were resumed in the district of Tadla in 1946. Nursery stock was frequently infested, and larvae were found in seedlings less than a year old. Larvae in older trees were not confined to the region of the root-collar ; some were in the roots at distances of over 2 yards from the trunk and others in the trunks themselves, almost as high as the main limbs. In the latter case, the larvae were sometimes moving up the trunk and sometimes downwards in the gallery by which they had ascended. It is suggested, therefore, that the larvae proceed from the root-collar to the roots, back to the root-collar, up the trunk and back to the root-collar again. The pupae, however, were found only in the root-collar or the roots, so that it appears that pupation takes place at or below soil-level, larvae in the roots pupating there and those in the trunk returning to soil-level to do so. The way in which the larvae move and feed in their galleries is described.

Observations in a nursery in which the trees were about 8 ins. apart indicated that the larvae may migrate from one tree to another [*cf.* **23** 141 ; **33** 384]. The infested area in Tadla is separated from the main infested area in north and north-east Morocco, so that the Buprestid apparently has very limited powers of spread ; it is probably distributed mainly with nursery stock. The damage caused varies with the species of tree and its state of vigour [*cf.* **33** 384]. Almond appeared to be resistant to injury, as were other fruit trees, notably peach, when grafted on almond.

The problem of whether *C. tenebrionis* is a primary pest or attacks only weakened trees is discussed. Root damage is sometimes due to fungous disease, which is favoured by the excessive watering practised by some growers, and many fruit trees, especially stone-fruits, have a short life in Morocco and become susceptible to attack by various insects and fungi after 10–12 years. Infestation by *Capnodis* may therefore well be secondary in character in numerous cases. Well-regulated irrigation is necessary for the trees to thrive, and in a large apricot orchard infested by *C. tenebrionis*, trees planted along an irrigation channel were the only ones to survive the attack, but too little or too much water favours infestation by its weakening effect. Infestation is easy to detect in nurseries because it leads to premature yellowing and fall of leaves, and it can be controlled by destroying plants showing these symptoms.

FÉRON (M.). **Recherches sur la ponte de** *Capnodis tenebrionis* **L. (Col. Buprestidae).**—*Rev. Path. vég.* **28** fasc. 1 pp. 66–72, 10 refs. Paris, 1949.

Although cage observations have indicated that *Capnodis tenebrionis* (L.) oviposits at the base of stone-fruit trees, the eggs have not been found in nature. A search for them was therefore made at Rivesaltes, Pyrénées-Orientales, in 1948. On 22nd June, 12 eggs, four of which had already hatched, were found in cracks in the bark of a peach stump brought to the laboratory ; the rest hatched on 25th June, and as the minimum incubation period is 12 days, they must have been laid during the first fortnight in June or earlier. Orchard trees were then examined in June-August, and eggs were found on apricot, peach and cherry. About 80 per cent. of a total of over 100 were on the trunks up to 6 ins. above the soil-surface (in cracks or on smooth bark), covered with earth and excreta, and the rest were on earth or stones, an inch or two away from the trunk. They occurred singly or in groups of up to 23, and the maximum number found on a single tree was 30. Of 14 trees on which eggs were found, 13 showed signs of decay. Females were seen on the soil, and one egg was subsequently found in the soil about 12 ins. away from the trunk of an apricot tree. During the investigations, two young larvae were found 2–3 ins. under the soil and about 2 ins. away from the trunk ; larvae were also found in roots about 3 ft. away from the trunk, with no gallery leading from the latter. It was therefore concluded that eggs are sometimes laid on the soil. Older larvae were not observed in the soil, and it is thought unlikely that these migrate [*cf.* preceding abstract].

Observations on the behaviour of the adults showed that they prefer sunny situations on the trees or ground ; they therefore tended to occur on young or unhealthy trees with poor foliage and at the base of the trunk. The site of oviposition is probably related to this preference. In cages in which branches were inserted into the ground, the females oviposited at temperatures above 26°C. [78·8°F.] [*cf. R.A.E.*, A **34** 369], and eggs were laid in the soil, one female depositing 120 in three hours. The process of oviposition is described.

DOSSE (G.). **Beiträge zur Bekämpfung des Grossen Kohltriebrüsslers** (*Ceutorrhynchus napi* **Gyll.**) **im Kohlbau.** [Contributions to the Control of the Large Cabbage Shoot Weevil in Cabbage Growing.]—*Anz. Schädlingsk.* **21** pt. 6 pp. 81–88, 12 refs. Berlin, 1948.

In view of the outbreaks of *Ceuthorrhynchus napi* Gylh. that have damaged rape and varieties of cabbage in western Germany since 1943, experiments on the control of the weevil on the latter were carried out in 1946 and 1947. Proprietary preparations containing unstated proportions of their active ingredients

were used. In preliminary laboratory tests, complete mortality of the adult weevils was given in a short time by a dinitro-o-cresol dust (Detal), which scorched the leaves, and a nicotine spray. Two dusts of derris and pyrethrum also gave complete mortality, but were somewhat slower in doing so, and one of derris alone (Kümex), though effective, was so slow as to be unsuitable for field use. A dust and a spray of DDT (Gesarol) were quite ineffective, but parathion dust and spray (E605 and E605f, respectively) gave complete kill, both in short periods, and two dusts of BHC (benzene hexachloride) (Nexit and Viton) also did so, though a little more slowly. As some of the effective materials were not obtainable in quantity, the field tests were made with the parathion and BHC dusts. These were about equal in effect and gave very good protection against the ovipositing overwintered weevils when applied several times at intervals of not more than five days. Treatment was begun in seed beds as soon as weevils were seen, on field crops as soon as they were planted out and on seed crops as soon as they began to shoot. In the case of the last, at least eight applications were required. Infestation of untreated plants was heavy.

Emmel (L.). **Vergleichende Untersuchungen der Wirkung von DDT- und 666-Staub auf den Kornkäfer und seine Brut.** [Comparative Investigations on the Action of Dusts of DDT and 666 on the Grain Weevil and its Progeny.]—*Anz. Schädlingsk.* **21** pt. 6 pp. 89–91, 1 ref. Berlin, 1948.

Batches of 50 adults of *Calandra granaria* (L.) were confined for 8 days with 50 gm. wheat in glass flasks closed with gauze, after which 0·05–2 gm. of 10 per cent. dusts of DDT or BHC (benzene hexachloride) or 0·2–2 gm. talc were mixed with the wheat. Examinations were made after a further 8 days and 6 weeks, and adults counted. The results showed that the DDT dust killed all the introduced weevils in 8 days at rates of 0·1–2 gm. and killed 98 per cent. and injured the remainder at 0·05 gm. The development of their progeny was notably affected only by rates of 1 and 2 gm., the numbers of newly emerged adults at the end of the experiment being under ten per flask as compared with 14–35 for the lower rates. Most of them were dead and the others fatally injured. Some that had emerged in wheat treated with 0·1 or 0·05 gm. dust, presumably towards the end of the period, were only slightly injured, and a few unaffected. In the BHC treatments, all the introduced weevils were dead in eight days and most of them completely dried up ; no young adults were subsequently found in grain treated at rates of 1 and 2 gm., and only one or two dead ones in grain treated at the lower rates. In the flasks in which talc was used, no weevils were killed or injured in 8 days and as many as 50–80 young adults per flask had emerged at the end of the experiment ; some had died owing to mechanical injury, but the numbers of these bore no relation to the rates at which the talc was used.

In tests of the effect of the dusts on the germination of the grain, DDT had no effect as compared with talc, though the percentage germination was somewhat higher at the lower than at the higher rates of application, but BHC was detrimental at all rates above 0·2 gm. The amounts of DDT and BHC used to protect grain are well below a level dangerous to warm-blooded animals, but even so, BHC is to be preferred, since it is less persistent than DDT. It should not be used, however, for grain intended for human consumption, since cakes prepared from wheat that was treated with 0·5 gm. BHC dust per 50 gm., kept for 5 weeks at 20–25°C. [68–77°F.] in a gauze-covered container and then thoroughly freed from dust and left uncovered for a further three weeks before being ground had a musty taste.

Bott (R.). **Der Einfluss des Kontaktstoffes "Gix" auf den Körper des Schädlings.** [The Effect of the Contact Substance "Gix" on the Body of the Pest.]—*Anz. Schädlingsk.* **21** pt. 6 pp. 91–95, 4 figs. Berlin, 1948.

An account is given of investigations of the mode of action on arthropods of Gix (a proprietary emulsion concentrate [of fluoro-DDT]). It proved toxic to adult mosquitos in a cage suspended 1 cm. above a piece of cardboard impregnated with the emulsion, though considerable time was required for mortality, and also to mosquito larvae in water into which it was introduced in two ways that prevented actual contact with the droplets. The author concludes that its effect was exercised by way of the body surface, the stomach or tracheal system playing no part. DDT has been considered to act through sense organs on the tarsi, but mosquito larvae have no legs and adult flies that had their legs embedded in paraffin wax so that they were unable to clean themselves died when droplets of the dilute emulsion were applied to various sites on the thorax and abdomen, while control insects remained active. DDT has also been considered to enter the body through the chitin of the cuticle by virtue of its lipoid solubility, but when a tube that contained dilute Gix emulsion and was closed at the end with chitin from the wings of beetles or dragonflies was suspended in water, mosquito larvae in the latter were not affected, and when a *Dytiscus* was killed by adding Gix to the water in which it was kept and then carefully washed with water, after which its body fluid was added to water containing mosquito larvae, none of the latter died, indicating that the Gix had not entered its body.

When mosquitos that had been killed by Gix without actual contact were examined under the microscope, patches of moisture were observed on their legs or on the side of the tube where they had rested. To investigate the nature of this, various arthropods or their extremities were placed in concentrated Gix emulsion and observed. It was found that several layers of bubbles appeared on the surfaces immersed, some of them clearly emanating from the pores, followed by an exudation of a material resembling protoplasm, which appeared to emanate from the neighbourhood of the joints. Similar, though less easily visible, phenomena followed immersion in a weak emulsion, and the appearance of the preliminary layer of bubbles followed immersion in dilute Canada balsam or cedar-wood oil, so that it may be connected with the presence of water. Insects that are covered with a wax layer, such as *Eriosoma* (*Schizoneura*) *lanuginosum* (Htg.), were not affected even by contact for several days with a Gix deposit and showed no exudation of body substance, and certain Dipterous larvae that live on salted animal skins and presumably lack the requisite pores were also unaffected. Susceptibility to Gix, therefore, appears to be related to the frequency of the pores.

Zacher (F.). **Mitteilungen über Diebkäfer (Ptinidae) von wirtschaftlicher Bedeutung.** [Notes on Ptinids of economic Importance.]—*Anz. Schädlingsk.* **21** pt. 7 pp. 97–103, 1 fig., 53 refs. Berlin, 1948.

As a supplement to Hinton's paper on Ptinids of economic importance [*R.A.E.*, A **29** 340], the author gives notes from the literature and his own work on 13 species, of which two were not referred to by Hinton, including information on their distribution, the type of damage caused, and in some cases distinguishing characters and life-history.

Yeager (J. F.) & Munson (S. C.). **A Ratio Hypothesis pertaining to the biological Action of Poisons and Drugs.**—*Ann. ent. Soc. Amer.* **41** no. 3 pp. 377–383, 3 graphs, 4 refs. Columbus, Ohio, 1948.

The authors give a more precise statement of the general form of a hypothesis presented in a paper already noticed [*R.A.E.*, A **37** 96] to explain the relationship found to exist between the concentration of poison administered and the survival time of cockroaches into which sodium-metarsenite solution has been injected. It is based on the assumption that the metarsenite solution contains two forms of chemical, only one of which is insecticidal, and that the ratio of the two varies with the concentration of the solution. An equation relating the concentration of active fraction to total concentration is calculated.

As present concepts of physical chemistry indicate that the sodium metarsenite must be considered to be completely ionised within the concentration range used, the physicochemical interpretation formerly offered, that only some of the molecules were ionised to free the toxic arsenite ion [*cf.* **33** 64 ; **35** 116 ; **37** 124], is discarded in favour of one based on a hydrolysis equilibrium. According to this, at or below a critical concentration all the arsenite ions or a constant proportion of them in buffered body fluid are hydrolysed into molecules of arsenious acid that ionise to a slight degree, whereas as the concentration increases above this level in a less buffered or unbuffered body fluid the proportion hydrolysed and un-ionised decreases to a minimum. The arsenite ions are considered to be the nontoxic form of the poison and the arsenious acid molecules the toxic form.

Boyce (A. M.). **Entomology of *Citrus* and its Contribution to entomological Principles and Practices.**—*J. econ. Ent.* **43** no. 6 pp. 741–766, 4 pp. refs. Menasha, Wis., 1950.

The author discusses some of the ways in which investigations of entomological problems relating to *Citrus* in the United States have resulted in substantial contributions to the development and elucidation of principles and practices of entomology. He describes the history of the crop and its pests in Florida, California, Texas and Arizona and of the legal enforcement of plant quarantines, commodity treatment and programmes of pest eradication and abatement. Some of the outstanding results obtained in biological control are reviewed, and the importance of foreign exploration for natural enemies of *Citrus* pests and of taxonomic and specialised biological investigations on species to be introduced is emphasised. The last include experiments on manipulated biological control, in which attempts are made to increase the effectiveness of natural enemies by mass culture and periodic colonisation in the field or by measures designed to alleviate the effect of factors adverse to them. Although *Citrus* investigations have contributed materially to the knowledge of a number of insecticides, the most significant early advances resulted from the work with petroleum-oil sprays and hydrocyanic acid gas, and these and contributions from work with other materials are mentioned, with the results of investigations on the development of resistance to insecticides in *Citrus* insects, on insecticide residues and on equipment for insecticide application.

Cooper (J. F.), Plummer (C. C.) & Shaw (J. G.). **The Citrus Blackfly Situation in Mexico.**—*J. econ. Ent.* **43** no. 6 pp. 767–773, 26 refs. Menasha, Wis., 1950.

The history of the spread of *Aleurocanthus woglumi* Ashby on *Citrus* in the western hemisphere, and particularly in Mexico [*cf. R.A.E.*, A **35** 77], is reviewed ; in its advance to the north of Mexico, it had reached Hermosillo,

Sonora, in the west by December 1949, and Metamoros, Tamaulipas, in the east just south of the Texas border by January 1950. Immature stages have been found in Mexico on 155 species of plants representing 61 families, of which *Citrus* is preferred. The Eulophid parasite, *Eretmocerus serius* Silv., has been widely released against the Aleurodid, but except in a small coastal area in Colima, the long dry season affects it adversely [*cf.* **39** 18]. Tests of insecticides [*cf.* **37** 192 ; **38** 294] showed that an emulsion of 1·67 U.S. gals. light-medium emulsive oil, containing 4·5 oz. cubé root (5 per cent. rotenone) per U.S. gal., in water to make 100 U.S. gals. gave the best control and that a spray of 28 oz. DDT in 2 U.S. quarts each of xylene and kerosene with 4 oz. blood-albumin spreader and water to make 100 U.S. gals. was also effective. Parathion preparations were toxic in preliminary experiments. In large-scale tests in western Mexico in 1947–49, 1–3 applications of insecticide, chiefly cubé in oil, reduced the population of *A. woglumi* and, in one area, the threat of immediate spread to the north. In eastern Mexico, six applications, mainly of cubé in oil, though DDT was used in the fifth or sixth on some trees, afforded good control, but experiments in other places showed that two properly timed applications would give good commercial control. On orange trees, as many as four applications of cubé in oil at intervals of 20 days, seven at intervals of 30 days and 10 at intervals of 40 days were applied before appreciable plant injury developed. DDT was applied 14 times at intervals of 20 days before there were any indications of injury. Coccids did not increase on plots treated with DDT at intervals of 20 or 30 days, but an oil spray had to be applied against *Parlatoria pergandei* Comst. when the intervals were 40–70 days. The organisation of the control investigations being carried out in Mexico by United States and Mexican bodies is described.

The rapid spread of *A. woglumi* in Mexico indicates that it may be impossible to prevent it from entering the United States, and sufficient inspection should be maintained in the *Citrus*-growing areas there to detect incipient infestations in time for them to be eradicated.

Dowden (P. B.), Carolin (V. M.) & Dirks (C. O.). **Natural Control Factors affecting the Spruce Budworm in the Adirondacks during 1946–48.**—*J. econ. Ent.* **43** no. 6 pp. 774–783, 7 refs. Menasha, Wis., 1950.

The following is largely based on the authors' summary. An outbreak of *Choristoneura* (*Archips*) *fumiferana* (Clem.) that broke out on *Abies balsamea* and spruce over a wide area in the Adirondacks of New York in 1945 had terminated by the end of 1948 without causing serious tree mortality, whereas infestation by the Tortricid in other parts of North America continued to be heavy or increased during the same period. Observations on the natural factors affecting it in New York are reported in this paper, which is additional to one already noticed [*R.A.E.*, A **37** 431].

Observations on nine tree stands of different types, well distributed throughout the heavily infested area, showed that overwintering mortality (estimated at 75–80 per cent.), entomophagous parasites and insectivorous birds were principally responsible for the reduction in infestation. A list is given of 16 additional insect parasites [*cf. loc. cit.*], of which eight had not previously been recorded from *C. fumiferana*. The relative abundance of the different parasites varied considerably over three seasons, but aggregate parasitism averaged 62–75 per cent. The effect of insectivorous birds was not accurately estimated, but general observations indicated that they might have accounted for a large proportion of the mortality credited to unknown factors. Obviously, a combination of environmental conditions proved particularly favourable to natural enemies during this outbreak, but their nature remains obscure.

DeBach (P.), Dietrick (E. J.), Fleschner (C. A.) & Fisher (T. W.). **Periodic Colonization of *Aphytis* for Control of the California Red Scale. Preliminary Tests, 1949.**—*J. econ. Ent.* **43** no. 6 pp. 783–802, 5 figs., 6 refs. Menasha, Wis., 1950.

Aphytis chrysomphali (Merc.) gives very satisfactory control of *Aonidiella aurantii* (Mask.) in certain untreated *Citrus* orchards in southern California, and it would probably do so more generally in favourable areas if the use of insecticides against this or other pests had not prevented the establishment of a balance between parasite and host, though there are indications that *A. aurantii* may not be so amenable to control by *Aphytis* in certain areas or on certain varieties of *Citrus* as elsewhere.

It is possible that the effects of unfavourable environment or insecticide treatment might be alleviated by artificial colonisation of the parasites in the field. Where natural abiotic factors are periodically unfavourable to *Aphytis*, colonisation at regular intervals might be necessary to maintain a satisfactory balance, but where regular insecticidal treatments have alone prevented the establishment of a natural balance, an initial release might suffice to bring about such a balance. Tests to find whether satisfactory control could be obtained by releasing very large numbers of parasites at frequent intervals were carried out in eight groves in 1949. The results were assessed by an insecticidal check method [*R.A.E.*, A **36** 145], a sleeve-cage comparison method [**38** 253] or comparison of populations on trees on which the parasites were inhibited by the Argentine ant [*Iridomyrmex humilis* Mayr] and on those on which they were not. Additional information on the effectiveness of the parasites, including data on scale population density, degree of parasitism, stages of scale present and parasitised, and proportion of dead and stung scales, was obtained by quantitative field studies. The sampling procedure and laboratory technique are described in some detail.

In November 1947, another species of *Aphytis* was introduced on Florida red scale [*Chrysomphalus ficus* Ashm.] from China. It differed from the local *A. chrysomphali* in pupal pigmentation, in the occurrence of males and in the greater robustness and darker colour of the females, and is referred to as *Aphytis* A. It was released against *Aonidiella aurantii* in July 1948 and was reproducing freely in the field by the autumn. As it appeared to be about as efficient as *Aphytis chrysomphali* and was much easier to propagate in the insectary, it was therefore tested in larger numbers in 1949. The results obtained from the periodic releases of the two species in various test groves are discussed. Good commercial control was obtained in 1949. *A. chrysomphali* appeared to disperse somewhat more readily than *Aphytis* A and was possibly less susceptible to low temperatures and more so to low humidities, but it appeared that the two forms may show certain differences that favour one or other of them in a given locality or set of circumstances. The results of somewhat irregular liberations of parasites and studies of trends of insect development indicated that periodic releases against *Aonidiella* would be most effective if made between 15th February and 15th April (after the last killing frost), 15th June and 15th July, and 15th August and 15th October, and calculations of the probable cost of producing and liberating the numbers of parasites required indicate that the average cost might be considerably less than that of control by insecticides.

Bartlett (B. R.) & Fisher (T. W.). **Laboratory Propagation of *Aphytis chrysomphali* for Release to control California Red Scale.**—*J. econ. Ent.* **43** no. 6 pp. 802–806, 2 figs., 4 refs. Menasha, Wis., 1950.

Investigations at Riverside, California, on the reproduction response of *Aphytis chrysomphali* (Merc.), an Aphelinid parasite of *Aonidiella aurantii*

(Mask.) on *Citrus* [*cf.* preceding abstract], showed that the parasite attacked the females during the second and third instars and the males during the second instar and prepupal and pupal stages. The preoviposition period was less than 24 hours, and oviposition was not retarded by semi-darkness. The optimum temperature and relative humidity for insectary rearing were 80°F. and about 60 per cent. Higher temperatures shortened the life of the adult parasites, and relative humidities below 20 per cent. were fatal to them within a few hours at temperatures above 70°. The males were the preferred hosts among scales reared on potato tubers and the third-instar females on grapefruit. When an equal choice was given, scales on grapefruit were preferred for oviposition. Adults that emerged from third-instar female scales on grapefruit lived longer than those from male scales on potato.

The authors describe a method based on this information that proved moderately successful for the production of adults for field release. Trays were used to rear foundation stocks of the scale on potato tubers and infest mature grapefruits with developing young from them [*cf. R.A.E.*, A **37** 256]. When the grapefruits showed 10 per cent. prepupal males, they were exposed in an insectary room stocked with *Aphytis* for 5–6 days for oviposition in the male scales and an additional 8–9 days for oviposition in the females, and then transferred to emergence units, each consisting of a darkened box with a plastic funnel securely fastened over an opening at one end. A collecting tube containing streaks of honey was attached to the projecting end of the funnel, and 85–95 per cent. of the emerging parasites followed the light gradient and were trapped in the tube for liberation or return to the oviposition room. Infested trays of potatoes were handled similarly, except that exposure was for only 5–6 days, since female third-instar scales are not used on these. By this procedure, 15,000–18,000 parasites per week were reared from Coccids on four trays of grapefruits (60 fruits per tray), one tray of 120 egg-size potato tubers being used for rearing the foundation stock.

DeBach (P.), Fleschner (C. A.) & Dietrick (E. J.). **Studies of the Efficacy of natural Enemies of Citrus Red Mite in southern California.**—*J. econ. Ent.* **43** no. 6 pp. 807–819, 10 graphs, 12 refs. Menasha, Wis., 1950.

The following is based on the authors' introduction and summary. *Paratetranychus citri* (McG.), which is now one of the major pests of *Citrus* in southern California, was a minor pest of sporadic occurrence for 10–20 years after its introduction from Florida in about 1890 [*cf. R.A.E.*, A **37** 288]. The reasons for its present prevalence are not clear, but in view of DeBach's earlier investigation [**37** 213], experimental and quantitative field studies were made concerning the relative efficiency of natural enemies and other factors in its control.

Studies in *Citrus* groves in southern California that had received no insecticidal applications for 3–10 or more years indicated that predators were chiefly responsible for the reduction of mite populations or for their maintenance at low levels. In such groves there may be satisfactory natural control of *P. citri* for several years at a time. The most effective predators, in approximate order of importance, were several species of Coniopterygids, *Stethorus picipes* Csy., *Chrysopa californica* Coq., several polyphagous species of Coccinellids and *Oligota* (*Somatium*) *oviformis* (Csy.). Quantitative data and experimental tests demonstrated the efficacy of the predators.

Cyclical trends were evident in mite and predator populations in Orange County. The mite tended to increase during the autumn and winter, although a winter reduction in some groves resulted in minimum populations by about

February. Peaks of mite population occurred about May or June, and subsequent reductions resulted in minimum populations during the summer. *Stethorus* populations increased during the autumn and winter and decreased in late spring, whereas Coniopterygid populations increased during the spring, remained large throughout the summer and decreased in the autumn.

Meteorological factors, especially combinations of low humidity with high temperatures, caused occasional reductions in populations of the mite. Reductions in certain populations of *P. citri* in the autumn were caused by unknown factors.

HUFFAKER (C. B.) & SPITZER jr. (C. H.). **Some Factors affecting Red Mite Populations on Pears in California.**—*J. econ. Ent.* **43** no. 6 pp. 819–831, 3 figs., 10 refs. Menasha, Wis., 1950.

Since the general adoption of DDT for the control of the codling moth [*Cydia pomonella* (L.)] on apple and pear, outbreaks of red mites on these trees have become a problem. An ecological study of the relation between the mites on pear in California, their natural enemies and the insecticidal practices common under field conditions was therefore initiated to ascertain whether the increase in mites was due to the destruction of predators by DDT or to some other factor.

In cage tests in 1948–49, bean plants sprayed or injected with DDT or left untreated showed no consistent differences in the development of infestations of *Tetranychus bimaculatus* Harvey in the absence of natural enemies, but other tests and greenhouse and field observations on pear trees infested with *Paratetranychus pilosus* (C. & F.), though inconsistent in results, supported the theory that infestation is increased by plant stimulation due to DDT [*cf. R.A.E.*, A **37** 468]. Mass distribution of eggs of *Chrysopa californica* Coq. in 1948 in pear orchards sprayed with DDT resulted in significant reductions of both mites, but failed to prevent conspicuous economic loss. Greenhouse tests in which winds of three velocities were simulated by means of electric fans showed that strong wind is an inhibiting factor in the early development of a population of *T. bimaculatus*, independent of the presence of residues of DDT dusts and sprays.

Comparison of trees that had been sprayed with lead arsenate in 1948 and received four lead arsenate sprays without oil, various DDT sprays or no treatment in 1949 showed that the average mite densities were lower on trees receiving lead arsenate or small quantities of DDT in four applications than on untreated trees or those receiving as much or more DDT in fewer applications, possibly owing to the washing effect of the sprays, but there was no consistent relation between predator and mite densities. Mites were rare and predators absent on a block of trees receiving lead arsenate and oil. In 1950, laboratory comparison of lead arsenate, alone and with oil, oil alone and DDT showed that oil alone had a higher residual ovicidal effect than lead arsenate and oil, and that oil alone or with lead arsenate had a pronounced residual effect on the nymphs, whereas lead arsenate alone or DDT had none. Field observations confirmed that the inclusion of oil in early sprays of lead arsenate, even at concentrations of less than 1 per cent., effected a mass destruction of overwintered mite eggs and young nymphs at a time when the populations had already reached their lowest annual levels ; the repetition of this procedure at frequent intervals appears to have been sufficient to keep red mites at a low level in the fruit-growing districts of California. There was no indication that predators (*Stethorus* and *C. californica*) exerted any practical control.

ENGLISH (L. L.). **Azobenzene as an effective Supplement in Organic Phosphate Aerosols for Control of the Two-spotted Spider Mite.**—*J. econ. Ent.* **43** no. 6 pp. 838–843, 6 graphs, 8 refs. Menasha, Wis., 1950.

The results are given of greenhouse experiments in Illinois on the effect of adding azobenzene to organic phosphates in aerosols used against *Tetranychus bimaculatus* Harvey on rose. Technical parathion, TEPP (75 per cent. tetraethyl pyrophosphate and 7·8 per cent. triethylphosphate) or tetraethyl dithionopyrophosphate was used in a propellent of methyl chloride that was 99·5 per cent. pure and contained not more than 0·008 per cent. moisture by weight, and a technical azobenzene melting at 66–68°C. was added. Standard 4-lb. aerosol dispensers were partially loaded with the exact dosage for each test and discharged in greenhouses with a capacity of 9,200 cu. ft. ; the azobenzene was loaded dry, the phosphate washed into a separatory funnel with acetone and allowed to flow into the evacuated bomb and 0·4 lb. methyl chloride added. Treatments were made in the morning, when the air temperature reached 72°F., and the houses were ventilated after two hours. The plants were moved to another house an hour later and examined for infestation after 2–8 days. All dosages given are per 1,000 cu. ft.

Parathion at 1 gm. killed about 60 per cent. of the mites without azobenzene and 96–100 per cent. when supplemented with 0·25–4 gm. azobenzene. Efficiency was also increased when dosages of 0·125, 0·25 and 0·5 gm. parathion were supplemented with 2 gm. azobenzene, and similar results were obtained with TEPP and tetraethyl dithionopyrophosphate in place of the parathion. Further tests in which the dosages of azobenzene or phosphates were varied showed that the effectiveness of the combinations was due to the effect of the phosphates on the active mites and the azobenzene on the eggs. The phosphates showed essentially no ovicidal effect, whereas azobenzene at 2 gm. per 1,000 cu. ft. without a phosphate killed 87·8–99 per cent. of the eggs. The ovicidal effect of the azobenzene was usually increased when the phosphates, particularly parathion or tetraethyl dithionopyrophosphate, were added. Azobenzene had relatively little effect against active or resting stages of the mite.

In commercial tests, in which infested roses growing in a 50-foot house were treated with a dosage of 1 gm. parathion and 1 gm. azobenzene on 9th May 1949, population counts showed a decline from 73 living mites per leaflet at the time of treatment to 0·4 per leaflet on 20th May. The population began to increase again by 31st May. The same treatment applied on 10th June to small elm trees in a 50-foot greenhouse almost eliminated the mite population in three days and kept it low for two months. In a large greenhouse consisting of seven 400-foot units, treatment with an aerosol to give a dosage of 1·5 gm. azobenzene, 0·75 gm. parathion and 0·25 gm. TEPP on 12th August 1949 reduced the mite population on roses from 29·4 to 6·9 per leaflet by 26th August, and after a second treatment on 2nd September, it was difficult to find living mites in six of the houses, though control was poor in the seventh. This house, which had received four applications of parathion aerosols at the rate of 0·5 gm. per 1,000 cu. ft. within two weeks from 26th July 1948 and 14 at the rate of 1 gm. per 1,000 cu. ft. between 29th October 1948 and 12th July 1949, was treated again on 9th September with the mixture, with poor results, and five additional treatments with several formulations in October-February also failed to give control. In February, mites from this house were cultured on potted roses and treated with an aerosol giving a dosage of 1 gm. parathion, and six days later only 8 per cent. were dead, indicating a high degree of resistance to parathion [*cf. R.A.E.*, A **39** 169]. It was evident that an ovicide did not reduce the population adequately without the addition of an effective poison against

the ovipositing adults. Azobenzene used in aerosols at dosages of 1–1·5 gm. in the commercial tests caused no leaf drop and no loss of colour of the flowers.

ASQUITH (D.). **Concentrated Sprays to control Plum Curculio on Peach.**—*J. econ. Ent.* **43** no. 6 pp. 843–845, 1 ref. Menasha, Wis., 1950.

Experiments to determine whether concentrated insecticidal sprays applied as mists would control the plum curculio [*Conotrachelus nenuphar* (Hbst.)] in commercial peach orchards were carried out in Pennsylvania in 1950. High-pressure sprays were applied at about 4 U.S. gals. per tree and mists at 3–4 U.S. quarts per tree. Sprays containing 1·5, 1 and 1 lb. 15 per cent. parathion per 100 U.S. gals. and mist concentrates containing four times as much were applied on 11th, 17th and 24th May, respectively, and sprays containing 1 lb. 25 per cent. dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene] per 100 U.S. gals. and mists containing four times as much were applied on 11th and 21st May. Micronised sulphur was included in all treatments on 11th and 24th May. The mist concentrates were applied at a forward speed of 2·5 miles per hour, and both sides of the machine were used. The air blast aimed at each row of trees was 8,000 cu. ft. per minute at 80 m.p.h. Experience in commercial orchards with larger machines indicated that air blasts as great as 25,000 cu. ft. per minute at 80–90 m.p.h. can be used provided that the forward speed of the machine is fast enough to prevent injury to the trees by air blast.

Collection of larvae from dropped and thinned peaches from four trees on each plot showed that the percentages of infested fruits were 0·2–1·1 for the dieldrin mist, 0–0·38 for the dieldrin spray, 0–1·25 for the parathion mist, 0·72–7·6 for the parathion spray, and 33·47 for no treatment. It is pointed out that in commercial practice an additional parathion spray would have been applied about 2nd June to extend the period of protection from attack ; that the parathion plots were near the unsprayed trees, so that adults migrating from these after the parathion residue had dropped below the toxic level damaged many fruits ; and that rainfall between 11th and 31st May caused the adults to leave their hibernation quarters over a long period and subjected insecticide residues to unusually heavy washing. It was evident that parathion and dieldrin at four times the standard spray concentrations were effective as mists when applied at about a fifth to a quarter of the normal spray quantities. The dieldrin residue showed a more persistent toxicity than the parathion, and this may facilitate control with fewer sprays where attack occurs early in the season and there is no chance of leaving dieldrin residues on the fruit at harvest.

NISHIDA (T.) & BESS (H. A.). **Applied Ecology in Melon Fly Control.**—*J. econ. Ent.* **43** no. 6 pp. 877–883, 2 graphs, 8 refs. Menasha, Wis., 1950.

Because of the very serious damage caused by *Dacus cucurbitae* Coq. to cucurbits and tomatos in the Hawaiian Islands and the lack of satisfactory methods of control, studies were carried out from November 1948 to October 1949 on the field ecology of the fly, and it was found that it had characteristic habits and movements of which advantage could be taken in the application of insecticides. On Oahu and Maui, observations, population counts and determinations of the physiological age of the females within fields of tomatos and cucurbits and in the adjoining vegetation showed that gravid females usually formed 90 per cent. or more of the adult population in the fields, apparently entering them to oviposit rather than to feed. Practically all of them left before dusk and spent the night on neighbouring vegetation, where there were also relatively large numbers of males and immature females, so that crops were practically free of flies during the night and early morning. Flies were most numerous in

the crops and oviposition greatest in the late afternoon. Males and immature females left the fields soon after emerging to congregate on such plants as castor (*Ricinus communis*), cocklebur (*Xanthium saccharatum*), Jimson weed (*Datura stramonium*) and pigeon pea (*Cajanus cajan*) not far away, and seldom entered the fields.

In preliminary tests, an oil emulsion containing 10–12 per cent. DDT, applied to the vegetation immediately outside melon and tomato fields with a mist blower before or soon after sunrise or late in the evening, eliminated practically all flies within 50–100 ft. of the blower. When applied on 25th February and 3rd, 10th and 19th March to the vegetation round a tomato field in a valley in which all tomatos, melons and cucumbers were being severely injured in spite of regular dusting with DDT, the mist spray reduced the average percentage infestation of tomato fruits to 2, 2 and 4 on 21st and 28th March and 6th April, respectively, as compared with 68, 63 and 63 in untreated fields less than a mile away. On an isolated farm in which tomatos and cucumbers were grown continuously for several months without insecticide applications against the fly, the average infestation on tomatos was kept to less than 5 per cent. by careful field sanitation. This involved removing self-sown plants, picking all fruits before flies had time to develop in them and destroying all those found infested, and traversing each row about once a week to collect all the flies seen.

Wilcox (J.) & Howland (A. F.). **Tests of new Insecticides for Control of Tomato Insects in southern California.**—*J. econ. Ent.* **43** no. 6 pp. 883–887, 2 refs. Menasha, Wis., 1950.

The following is based on the authors' introduction and summary. In 1945–49, some of the newer insecticides were tested with a view to developing a formulation that would control the major pests of tomato in southern California. These include *Heliothis armigera* (Hb.), which was the most important during the period of the tests, *Laphygma exigua* (Hb.), *Protoparce* spp., cutworms, a serpentine leaf-miner referred to as *Liriomyza pusilla* (Mg.) [*cf. R.A.E.*, A **34** 57], and the mite, *Vasates destructor* (Keif.).

Excellent control of *H. armigera* was obtained with dusts containing 5 or 10 per cent. DDT or DDD (TDE [dichlorodiphenyldichloroethane]), 1 per cent. aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene] or a mixture of 5 per cent. chlordan and 5 per cent. DDT. A dust of 2·5 per cent. dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene] was promising in limited tests. Toxaphene as a 20 per cent. dust gave satisfactory control in 1948 but was inferior to a dust of 10 per cent. DDT in 1947 and 1949. Less effective materials were dusts containing 10 per cent. toxaphene (alone or with 2 per cent. DDT), 75 per cent. calcium arsenate, 10 per cent. fluoro-DDT, 2·5 per cent. 2-nitro-1,1-bis(p-chlorophenyl)propane, 2-nitro-1,1-bis(p-chlorophenyl)butane or aldrin, 5 and 10 per cent. methoxy-DDT (methoxychlor), 2, 5 and 10 per cent. chlordan, 70 per cent. cryolite, BHC (benzene hexachloride) at concentrations giving 2, 2·5 and 5 per cent. γ isomer, and 2 per cent. lindane [at least 99 per cent. γ BHC]. Dusts containing 50 per cent. *Ryania* or 2 per cent. parathion were relatively ineffective against this insect. Concentrated emulsion sprays containing 2·5 per cent. DDT or 5 per cent. toxaphene gave good to excellent control, but the same type of spray containing 2·5 per cent. chlordan or γ BHC, as lindane or otherwise, was relatively ineffective.

Dusts containing 5 or 10 per cent. DDT, 5 per cent. DDD, 10 per cent. toxaphene or 75 per cent. calcium arsenate were effective against *Laphygma*, but a dust containing 5 per cent. methoxy-DDT gave poorer results, and one

containing 50 per cent. *Ryania* was ineffective. A dust containing 10 per cent. DDT was effective, and one containing 50 per cent. *Ryania* ineffective, against *Protoparce*.

Dust mixtures containing 25 per cent. sulphur were effective against *V. destructor*, and in one experiment, one containing 5 per cent. chlordan and no sulphur was almost as good. Dusts containing 2 per cent. chlordan, 2·5 or 5 per cent. γ BHC or 2·5 per cent. aldrin or dieldrin, all without sulphur, and undiluted calcium arsenate were less effective.

CHAMBERLIN (T. R.) & MEDLER (J. T.). **Further Tests of Insecticides to control Meadow Spittlebugs on Alfalfa.**—*J. econ. Ent.* **43** no. 6 pp. 888–891, 2 refs. Menasha, Wis., 1950.

Further tests of insecticides against *Philaenus leucophthalmus* (L.) on lucerne grown for seed in Wisconsin [*cf. R.A.E.*, A **38** 283] were made in 1949. Alternating periods of unusually high and low temperatures in spring delayed the appearance and development of *Philaenus* but not the growth of the plants. These conditions caused some difficulty in timing spray applications, and in some cases this may have resulted in erratic performance of materials. The insecticides were applied at 5–20 U.S. gals. per acre at a pressure of 40–45 lb. per sq. in. with tractor sprayers, and the results were assessed mainly from the proportions of stems bearing froth masses in treated and untreated plots. Toxaphene, chlordan, DDT, lindane [at least 99 per cent. γ benzene hexachloride], aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene] and dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene] were applied as emulsion sprays, lindane also as a water suspension, and methoxy-DDT (methoxychlor) and parathion as water suspensions only. Rates of application of toxic materials are given per acre. Toxaphene gave 87–100 per cent. control when applied at 0·75–1·7 lb. to lucerne not more than 16 ins. high in May and rather less when applied at 1·5 lb. in June, when the plants were 18–26 ins. high. It was more consistently effective than chlordan, which gave 29–98 per cent. control when applied at 0·5–1·5 lb. in May and 28–71 per cent. when applied at 1 lb. in June. In limited tests, DDT applied at 1–1·5 lb. in May gave 93–99 per cent. control, lindane at 0·25 lb. in May gave 74–100 per cent., lindane at 0·25 and 0·5 lb. in June gave 71 and 100 per cent., respectively, and aldrin at 0·25 lb. in May gave 0–63 per cent. In single tests, dieldrin at 0·25 lb. and parathion at 0·5 lb. in May and methoxy-DDT at 2 lb. in June gave 98·5, 75 and 30 per cent. control, respectively ; the parathion scorched the plants. It is concluded that lindane, DDT and dieldrin may be as effective as toxaphene, whereas aldrin and methoxy-DDT are ineffective. Differences in control due to rate of application were not noticeable for toxaphene at 0·75–1·5 lb., chlordan at 0·5–1·5 lb., DDT at 1–1·5 lb., lindane at 0·25–0·5 lb. or aldrin at 0·25–0·5 lb. On two farms, weather conditions and disease interfered with seed production, but on three others, the yields were 4·5, 5·1 and 7 bushels seed per acre, most of which was from the treated plots. The treatments described should not be used on lucerne that is to be fed to dairy cows or animals being fattened for slaughter.

MISTRIC jr. (W. J.) & RAINWATER (C. F.). **Laboratory Experiments to determine the insecticidal Action of several organic Insecticides against Boll Weevil.**—*J. econ. Ent.* **43** no. 6 pp. 892–898, 4 graphs, 8 refs. Menasha, Wis., 1950.

Certain organic insecticides are toxic to insects in more than one way, and in 1949, eight compounds were tested against adults of *Anthonomus grandis* Boh. in the laboratory at College Station, Texas, for stomach, contact and fumigating action, the last comprising the direct effect of the vapours on the insect and

the indirect effect resulting from the absorption of the vapours by the plant (probably largely stomach action) or their condensation on plant tissue (a combination of contact and stomach action).

The insecticides were applied as dusts, and the total effect of each was determined by treating cotton plants in a settling chamber and introducing the weevils when the dust had settled. Contact effect was observed by transferring dusted weevils to untreated plants, direct fumigating action by confining weevils in a jar containing the dust on the other side of a coarse wire screen, and indirect fumigating action by confining the tops of plants similarly for 24 hours, allowing them to stand in the open laboratory for one hour and then caging weevils on them. No satisfactory technique is known for determining stomach action alone against *A. grandis*, but it was assumed that any effect not caused by fumigation or contact would be due to stomach action. Each insecticide was tested for each type of action at several dosages, and graphs relating dosage and mortality due to total, contact and direct fumigating action are given. Aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene, dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a, 5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene] and BHC (benzene hexachloride containing about 12 per cent. γ isomer) all proved to be highly toxic by both fumigating and contact action. Chlordan had relatively high fumigating action, but less contact action than any other material tested. Aldrin and chlordan had most plant-fumigating effect, and DDT, toxaphene and CS-674A (technical 2-nitro-1,1-bis(p-chlorophenyl)butane) showed considerably more pronounced action from plant fumigation than from direct fumigation. BHC and dieldrin also showed significant results due to plant fumigation, but CS–645A (technical 2-nitro-1,1-bis(p-chlorophenyl)propane) did not. Dieldrin gave outstanding kill by contact action, though knockdown was slower than for other materials. Aldrin and BHC also had high contact action, and DDT had more than toxaphene. The results showed that toxaphene and CS–645A killed the weevils mainly by stomach action and that chlordan must kill largely by this means. Stomach action contributed greatly to the total effect from all the insecticides tested, dieldrin being the only one to show an effect independent of stomach action that might approach practical control.

The α, β, γ and δ isomers of BHC were compared with the technical compound to determine how much of its contact and fumigating action was due to each. The four isomers showed different types of action. The γ isomer was considerably more effective than any other as a fumigant at low concentrations, but increased in efficiency very slowly as concentrations rose, whereas the α, β and δ isomers increased rather rapidly in effectiveness. The β isomer was the least effective throughout most of the range. In plant fumigation, the β and γ isomers were virtually ineffective ; the δ isomer contributed considerably more to total toxic effect than any of the others, but the α isomer also contributed significantly. The γ isomer caused most contact action ; the α and δ isomers contributed little individually, though their combined contributions were significant, and the β isomer was the least effective.

EIDE (P. M.) & STITT (L. L.). **Comparisons of Insecticides for Cabbage Maggot Control.**—*J. econ. Ent.* **43** no. 6 pp. 899–905. Menasha, Wis., 1950.

Hylemyia brassicae (Bch.) is a serious pest of cruciferous crops in western Washington, probably owing to the mild winters and cool moist summers. In 1948–49, field tests were carried out at Puyallup, where the principal crops are cauliflower and broccoli grown for market or processing, and in the Skagit Valley, where the crops are grown principally for seed, to determine the effectiveness of different insecticides. Chlordan, aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,

5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene], dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene], BHC (benzene hexachloride), and lindane [at least 99 per cent. γ BHC], applied as dusts to the soil before planting or about the base of the plants, and the first three applied in a concentrated emulsion dip or concentrated dust to the roots and stems before planting or as drenches during or after planting, all gave good control of *H. brassicae* in broccoli, cauliflower and seed-cabbage plantings. Parathion gave good control when applied in dusts round the plants or as a drench at the time of planting but was less effective when applied as a dust to the roots and stems or to the soil before planting. Toxaphene was applied in dusts or emulsions to roots and stems or as a liquid at planting, but was less effective and caused some stunting of plants. Methyl-DDT (ditolyl trichloroethane), methoxy-DDT (methoxychlor) and DDT gave poor results when used as 5 per cent. dusts, but the last two were effective when applied to the roots and stems in a 50 per cent. dust.

None of the materials damaged the plants when used as dusts, but BHC caused serious stunting when used as a drench and chlordan emulsion caused slight injury under some conditions. Dipping was by far the cheapest, though not the most effective, method of application.

Ahmed (D. D.) & Davidson (R. H.). **Life History of the Meadow Spittlebug in Ohio.**—*J. econ. Ent.* **43** no. 6 pp. 905–908, 1 fig., 6 refs. Menasha, Wis., 1950.

The author describes all stages of *Philaenus leucophthalmus* (L.) and gives the results of studies on its life-history in Ohio in 1948–49. Adults caged on potted lucerne plants in late September deposited eggs in groups of 2–17 between sheaths and stems or in cracks in the stems, not more than 2–3 inches from the soil surface. Eggs that had overwintered in the field and were brought into the greenhouse in spring hatched in April, and the nymphs transformed to adults in May after an average period of 34 days at temperatures of 65–100°F. and relative humidities of 90–35 per cent. Low temperatures greatly retarded development. In the field, the eggs overwintered in stubble, hatching began about 10th April, the nymphal stage lasted about 45 days and adults began to appear about 24th May and to die off when cold weather began in autumn. Oviposition began in late August or early September. The bugs preferred succulent plants and tender growth, and one or more nymphs of the same or different instars could be found within a single large mass of froth. Lack of moisture seemed to prevent development, particularly in the early instars. All moulting occurred within the froth mass. The method of making the froth and its composition are described. Adult populations in the field fluctuated with the cutting of forage crops, the adults migrating from cut to neighbouring uncut fields.

Mayeux (H. S.) & Wene (G. P.). **Control of Onion Thrips with Low Volume Sprays.**—*J. econ. Ent.* **43** no. 6 pp. 908–912, 8 refs. Menasha, Wis., 1950.

In the Lower Rio Grande Valley of Texas, profitable onion production is usually impossible without control of *Thrips tabaci* Lind. Control with dusts is hampered by high winds, and high-volume sprays are seldom used because of the initial cost and the scarcity of water. Experiments were therefore carried out to evaluate low-volume sprays for thrips control. A dust containing 1 per cent. γ BHC (benzene hexachloride), 5 per cent. DDT and 70 per cent. sulphur, applied on 19th February and 9th March at 20 lb. per acre, and an emulsifiable concentrate applied at the rate of 1 U.S. pint containing 8 oz.

toxaphene and 4 oz. DDT, diluted in 5 U.S. gals. water, per acre on 18th and 25th February and 7th March reduced the seasonal averages of thrips per plant from 55 to 6·5 and 4·8, respectively. The spray proved effective in winds that prohibited dusting. The application of 8 oz. toxaphene and 4 oz. DDT in 8 U.S. gals. water per acre on 15th February and 11th March and of a high-volume spray of 3 lb. 50 per cent. wettable DDT in 100 U.S. gals. water per acre on 12th and 25th February and 11th March reduced the average number per plant from 23·9 to 6·2 and 7, respectively. A single application of 8 oz. toxaphene and 4 oz. DDT in 5 U.S. gals. water was made on an acre of onions in the centre of a 50-acre field when the wind was blowing at more than 25 miles per hour, and two inches of rain fell within nine hours after treatment. The average number of thrips per plant nine days later was 2, as compared with 14 in the rest of the field.

In one test, the application of 8 oz. toxaphene and 4 oz. DDT as an emulsifiable concentrate in 5 U.S. gals. water per acre by ground machine and of 12 oz. toxaphene and 6 oz. DDT in 2 U.S. gals. per acre by aeroplane, twice at an interval of seven days, both gave good control, but the former was the more effective ; and in another, weekly applications of a spray of 8 oz. DDT in 5 U.S. gals. water with ground equipment or a dust of 1 per cent. γ BHC (benzene hexachloride) and 5 per cent. DDT at 20 lb. per acre with ground equipment or at 30 lb. per acre by aeroplane from the time the first thrips appeared all gave good control and yields of about 42 56-lb. bags of onions per acre, but when the application of the spray was delayed until thrips injury became noticeable on the onions, two applications were required to bring the thrips under control, and the yields from this plot and one treated with the spray by aeroplane at irregular intervals were no more than that on untreated ones (27 bags per acre).

When applied in 5 U.S. gals. water per acre to onions about five inches high at a mean temperature of 70°F., 8 oz. dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene] was slightly more effective than 8 oz. DDT or 16 oz. aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene] and 4 oz. γ BHC slightly less so in one test ; 8 oz. heptachlor [1 (or 3a),4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-4,7-endomethanoindene] was more effective than 24 oz. toxaphene, 16 oz. chlordan or 8 oz. methoxy-DDT (methoxychlor) in another ; and mixtures of 4 oz. DDT or 8 or 16 oz. toxaphene with 2 oz. γ BHC were better than 8 oz. DDT, 4 oz. γ BHC or 16 oz. toxaphene alone in a third.

Richardson (C. H.) & Du Chanois (F. R.). **Codling Moth Infestation in the Tops of sprayed and of unsprayed Apple Trees : Second Report.**—*J. econ. Ent.* **43** no. 6 pp. 912–914, 1 ref. Menasha, Wis., 1950.

The following is substantially the authors' summary. In central Iowa in 1950, the percentages of apples infested by the codling moth [*Cydia pomonella* (L.)] on trees 17 ft. high that were sprayed according to a modified DDT schedule were 3–6 times as great in the tops as in the lower parts, and young sprayed trees 12 ft. high had 2–3 times as heavy an infestation in the tops as in the lower parts [*cf. R.A.E.*, A **39** 111]. In a controlled experiment, spraying caused a greater reduction of infestation in the lower parts than in the tops of young trees.

In unsprayed trees 25 ft. high, the ratio of the proportions of fruits infested in the tops and bottoms of the trees was 2 : 1 in late June and 1·1 : 1 in late July. The reduction was largely due to increased infestation in the lower parts, but the difference was still significant. Young unsprayed trees 12 ft. high tended to show higher top than lower peripheral infestations, and this is

probably about the height at which young unsprayed trees begin to reveal significant differences between the percentage of infestation at the top and bottom.

Dormal (S.), Delvaux (E. L.), Dills (L. E.) & Frear (D. E. H.). **Synthesis of chlorinated aromatic Compounds, chemical Structure and insecticidal Efficiency.**—*J. econ. Ent.* **43** no. 6 pp. 915–918, 3 graphs, 1 ref. Menasha, Wis., 1950.

The following is virtually the authors' summary. Chlorinated derivatives of naphthalene, anthracene, phenol, anisole, methyl-, dimethyl- and trimethylbenzene, indene, and coumarone were prepared. Insecticidal properties were tested on *Drosophila melanogaster* Mg., *Tenebrio molitor* L., *Tribolium confusum* Duv., *Aphis fabae* Scop. (*rumicis* auct.) and eggs of *Oncopeltus fasciatus* (Dall.). When derivatives of benzene, phenol, anisole, diene-one, indene and coumarone were chlorinated, the toxicity of the derivatives increased as the number of chlorine atoms in the molecule increased. With methylated benzene, naphthalene, and anthracene nuclei, however, the addition of chlorine had the opposite effect. There were no demonstrable correlations between percentage or number of chlorine atoms in these organic compounds and toxicity to insects.

Decker (G. C.), Weinman (C. J.) & Bann (J. M.). **A preliminary Report on the Rate of Insecticide Residue Loss from treated Plants.**—*J. econ. Ent.* **43** no. 6 pp. 919–927, 9 graphs, 8 refs. Menasha, Wis., 1950.

The following is based on the authors' summary, the end of which is misplaced, appearing on pp. 922–923. The rate of loss of residue after the application of sprays of seven insecticides to peach and apple trees and of five of them to soy bean, red clover, sweet clover [*Melilotus*] and lucerne was studied by chemical and biological assays of samples of leaves from the trees and whole stems from the other plants taken at various intervals after spraying. Deposits of DDT were significantly higher in relation to rate of application than those of toxaphene and were far in excess of those of the more volatile compounds, showing that there must be a considerable loss of even slowly volatile materials during the actual spraying process, and this was substantiated by the results of laboratory studies under controlled conditions. Deposit was also affected by differences in formulation.

Although there were individual variations in different series and different crops, the average results indicated that lindane [at least 99 per cent. γ benzene hexachloride] and parathion are the least persistent, followed by aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene], chlordan, dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene], toxaphene and DDT in that order. As they age, the insecticidal efficiency of the residues does not always follow the curves for the chemical analyses. Some compounds have such a low threshold of toxicity that an appreciable effect on house-flies [*Musca domestica* L.] can be demonstrated almost as long as there is any discernible residue on the plants, whereas other compounds persist long after all insecticidal activity has been lost. Residues of chlordan and toxaphene, particularly the latter, from applications of these insecticides as emulsions are very resistant to removal by heavy rains, apparently because of their waxy or sticky physical nature. The rate of loss of residues of materials that are mixtures of compounds, such as toxaphene, chlordan or crude aldrin, is not uniform, and plotting the rate of deterioration from such residues against the logarithm of time after application usually results in a multiple-phase curve.

Willis (E. R.) & Roth (L. M.). **The Attraction of *Tribolium castaneum* to Flour.**—*J. econ. Ent.* **43** no. 6 pp. 927–932, 4 figs., 13 refs. Menasha, Wis., 1950.

Little is known of the factors that govern the selection of food by adults of *Tribolium castaneum* (Hbst.). In experiments, adults that had been kept without food for two or more days were strongly attracted to wheat flour and to moisture in petri dishes, but subsequent tests indicated that unstarved undesiccated adults preferred low humidities, while starved and desiccated ones preferred high humidities ; no effect of flour odour could be demonstrated. The effect of the moisture content of the flour was further studied with the aid of a covered arena in which the attractant was placed under a screen floor. Beetles that had been starved for seven days under dry or moist conditions were little attracted to dried flour, but were attracted to flour with a moisture content of 10–12 per cent. ; as the period of starvation increased from 0 to 7 days, the attractiveness of the moist flour increased for beetles that had been kept under dry conditions and decreased for those kept under moist, and water vapour produced a similar reaction in the former. When samples of flour containing 7, 10, 12 and 15 per cent. moisture were offered to unstarved beetles, the latter showed little ability to discriminate between them, but responded to them all significantly. Beetles that had been starved for seven days in a current of air of 96–100 per cent. humidity or a current of dry air discriminated among the samples, much preferring the wettest, but those starved in the dry atmosphere were attracted more strongly to the wettest sample than those starved in moist air. Beetles that had been starved for seven days on dry filter paper showed a marked preference for the wettest when offered a choice of samples containing 7, 10, 12 and 15, 7, 10 and 12, or 7 and 10 per cent. moisture, but the response to the sample with the highest moisture content and the total response to all flour samples decreased as those with 15 and 12 per cent. moisture were successively removed.

These results suggest that under normal conditions, adults migrating from flour would wander, not strongly attracted to food, until their humidity responses were reversed by desiccation, and that the moisture content of the available food would affect the intensity of beetle invasion, damp storage conditions tending to foster high initial infestation by attracting desiccated migratory beetles.

Milner (M.), Lee (M. R.) & Katz (R.). **Application of X-ray Technique to the Detection of internal Insect Infestation of Grain.**—*J. econ. Ent.* **43** no. 6 pp. 933–935, 5 figs., 1 ref. Menasha, Wis., 1950.

The authors describe a radiographic technique for the detection of internal infestation of wheat grains by insects. *Calandra* (*Sitophilus*) *granaria* (L.) and *C.* (*S.*) *oryzae* (L.) were used and their development was followed from the hatching of the egg within the kernel to the emergence of the mature insect. In a typical experiment with *C. oryzae*, adults were confined in wheat for five days, after which they were removed by sieving. Kernels containing eggs were identified by a fluorescent staining technique specific for the gelatinous insect egg plug, and mounted on a single thickness of photographic black paper by means of a thin film of rubber cement. The back of this paper formed one lightproof face of the film-holding cassette, the kernels being in direct contact with a sheet of X-ray film. A Machlett cobalt-target X-ray diffraction tube with a beryllium window was found to be a satisfactory radiation source, and it was excited to a voltage of 12–30 k.v. at a current of 8–10 m.a. The infested grain was kept at a temperature of 75°F. throughout the experiment and exposed to

the X-rays for 3–5 seconds daily or at longer intervals up to two weeks. No inhibiting effects due to daily radiation were noted.

Radiographs of the grains taken 5, 13, 22 and 32 days after exposure to infestation by *C. oryzae* are reproduced to show that the egg channels, larvae, pupae and newly emerged adults in the kernels can be readily seen. In an ordinary photograph of the same kernels taken 40 days after exposure to infestation, when insect emergence was virtually complete, infestation could be detected only by the emergence holes and surrounding feeding débris. No external indication of internal infestation appears until emergence actually occurs. Although all the kernels shown contained egg plugs, which is a presumptive test for the presence of eggs, many failed to show any development of insects ; the same was true in kernels that were less frequently examined with X-rays.

POLIVKA (J. B.). **Comparative initial Effect of Insecticides in Control of Japanese Beetle Grubs.**—*J. econ. Ent.* **43** no. 6 p. 936, 2 refs. Menasha, Wis., 1950.

Two experiments were carried out in Ohio to show the relative speed of kill of different technical insecticides applied to turf at various times of year against larvae of *Popillia japonica* Newm.

In one in which lead arsenate, DDT, chlordan and toxaphene at 500, 25, 9·6 and 20 lb. per acre, respectively, were mixed with milorganite and broadcast with a small fertiliser spreader on 1st or 30th September or 2nd November 1948 and infestation was determined on 1st June 1949, significant reductions in population as compared with no treatment were given only by DDT applied on 1st September and chlordan and toxaphene applied on 1st or 30th September. The lead arsenate had presumably been applied too late to be effective by the following June.

In the other test, treatment in the same way on 11th April, 9th June or 10th August with 12·5 or 25 lb. DDT, 5 or 10 lb. chlordan or 1 or 5 lb. parathion per acre gave significant control in each case by 30th September, but for each date of application chlordan and parathion were much more effective than DDT.

KENAGA (E. E.). **The Relationship of molecular Weight to insecticidal Activity.**—*J. econ. Ent.* **43** no. 6 pp. 938–939, 1 ref. Menasha, Wis., 1950.

From a study of 44 commercial and experimental organic compounds known to possess insecticidal properties, the author concludes that there is a close relation between their molecular weights and their toxicity to arthropods. Organic salts were excluded, as those of many acids and phenols are not essentially different in toxicity from the parent compounds and their toxicity cannot be correlated with molecular weight. Ratings of effectiveness were based on toxicity to larvae of *Epilachna varivestis* Muls. and *Laphygma* (*Prodenia*) *eridania* (Cram.), adults and nymphs of *Aphis fabae* Scop., and adults and eggs of the mite, *Tetranychus bimaculatus* Harvey, and the ratings and molecular weights of the materials investigated are shown in a table. Their molecular weights ranged from 154 to 414 and those of the most active from 240 to 414 [*cf. R.A.E.*, A **37** 481], and it appeared that the further out of this latter range a chemical was, the less likely it was to be toxic, and if toxic, the less likely it was to be so to many species. Materials of low molecular weight tended to act by contact and those of high molecular weight by stomach action. The lower limit may depend on the readiness with which compounds of high volatility and solubility, which are associated with low molecular weight may

escape from the zone of action before they can be effective, and the upper limit on the inability of a heavy molecule to penetrate or dissolve in arthropod cells and fluids.

Fulton (R. A.), Smith (F. F.) & Konecky (M. S.). **Comparative Toxicity of Vapors of four organic Phosphates to Chrysanthemum Aphid and Two-spotted Spider Mite.**—*J. econ. Ent.* **43** no. 6 pp. 940–941, 4 refs. Menasha, Wis., 1950.

The results are given of experiments in which leaves freshly infested by the Aphid, *Macrosiphum* (*Macrosiphoniella*) *sanborni* Gill., and resistant and non-resistant forms of the mite, *Tetranychus bimaculatus* Harvey [*cf. R.A.E.*, A **39** 169] were exposed for various periods to air saturated with vapour from 38–40 per cent. TEPP (tetraethyl pyrophosphate), HETP (hexaethyl tetraphosphate containing 12–15 per cent. TEPP), technical tetraethyl dithiopyrophosphate or 98–99 per cent. parathion, to determine whether the vapours present in the air may account for the delayed mortality caused by aerosols of parathion and HETP [*cf.* **37** 469 ; **38** 221]. TEPP caused a higher mortality of Aphids and mites at shorter exposures than did HETP. All the Aphids were killed by TEPP in five minutes, and all the adults and nymphs of non-resistant mites in 15 minutes, but only 83 per cent. of the adults and 99 per cent. of the nymphs of resistant mites were affected after 120 minutes. All Aphids and non-resistant mites were killed in five minutes by tetraethyl dithiopyrophosphate, and after 120 minutes the kill of resistant mites approximated to that obtained with TEPP. Tetraethyl dithiopyrophosphate has a slower rate of hydrolysis than TEPP. Parathion gave complete kill of the Aphids in 10 minutes and of the nymphs and adults of the non-resistant mites in 3 and 7 hours, respectively, but killed only 67 and 41 per cent. of the resistant nymphs and adults in 16 hours. The concentration of vapour used in these tests was much higher than could be expected in a greenhouse, and it is evident that treated greenhouses should be kept closed for long periods.

Chisholm (R. D.), Koblitsky (L.), Fahey (J. E.) & Westlake (W. E.). **DDT Residues in Soil.**—*J. econ. Ent.* **43** no. 6 pp. 941–942, 3 refs. Menasha, Wis., 1950.

As a large proportion of the DDT applied for the control of insects of agricultural importance falls to the ground, investigations were made at various localities in Indiana, New Jersey, New York and Washington States to determine by chemical analysis the amount deposited in the soil annually and the rate of increase of the residues at different depths. The sampling methods used are described, and the results obtained in 1949 are discussed. Soil samples taken under elm trees sprayed for three seasons were found to contain residues equivalent to 137–194 lb. DDT per acre, and samples taken, after removal of the stalks and cultivation, from a maize field that had been dusted twice in 1949 contained the equivalent of 3·5 lb. DDT per acre in the top three-inch layer and 2 lb. in the next three inches. It was shown that DDT residues accumulated in the soil under trees in orchards and increased with each year of treatment. In uncultivated apple orchards in Indiana and Washington sprayed for 5 and 3 years, respectively, 90 per cent. of the total DDT determined was in the débris (96·8–176·8 lb. per acre) or near the surface, with little evidence of downward distribution. In cultivated orchards sprayed for up to five years, most of it was in the top three inches of soil (14·1–90·6 lb. per acre), and the proportions found in the next three inches appeared to depend on the depth of cultivation. The amounts present between the trees were probably lower than those under them.

Vinson (E. B.) & Arant (F. S.). **Parathion, Toxaphene and DDT Residues on Peanut Hay.**—*J. econ. Ent.* **43** no. 6 pp. 942–943, 9 refs. Menasha, Wis., 1950.

Parathion, toxaphene and DDT appear to be the most promising organic insecticides for the control of insects on groundnuts. As the dried groundnut plants are commonly fed to livestock in Alabama, there is danger of toxicity to the animals and also of harm to consumers of meat from them both from DDT and from toxaphene, which has been shown to accumulate similarly in the body fat, but is not passed so readily in milk. In 1948, groundnuts were dusted with 1 per cent. parathion, 10 per cent. toxaphene or 2 per cent. DDT at the rate of about 25 lb. per acre 9, 14, 25 or 35 days before harvest. Analysis of samples from the stored dried plants showed only traces of parathion on those from any dusted plot. Toxaphene residues varied from 23 to 4·2 parts per million, depending on the interval between dusting and harvest ; loss of residue was rapid for 9–14 days after application, but gradual subsequently. DDT residues varied similarly from 8·6 to 0·8 p.p.m. and showed a similar rate of loss to toxaphene.

Yust (H. R.). **Tests of liquefied-gas Aerosols used in Conjunction with Hydrocyanic Acid Fumigation to control Citrus Red Mite.**—*J. econ. Ent.* **43** no. 6 pp. 945–946, 2 refs. Menasha, Wis., 1950.

In an attempt to find a method of controlling both *Paratetranychus citri* (McG.), which is not susceptible to hydrocyanic acid gas, and *Aonidiella aurantii* (Mask.), which is, on *Citrus* in California, liquefied-gas aerosols containing di(p-chlorophenoxy)methane (Neotran) or parathion, acetone and methyl chloride (10 : 10 : 80) or HETP (hexaethyl tetraphosphate) and methyl chloride (10 : 90) were tested against the mite on lemons under fumigation tents in 1947–48. In preliminary tests, lemon fruits bearing eggs were exposed for 45 minutes to maximum dosages of 5 gm. HETP, parathion or Neotran per 1,000 cu. ft. under tents over tree forms, the aerosol being introduced near the top or in the air stream of an applicator with a propeller fan (designed for applying HCN). After treatment with HETP, 54 per cent. of the eggs hatched and the residue did not kill all the newly hatched mites, but after exposure to Neotran or parathion, 18 and 15·7 per cent. of the eggs hatched, respectively, and no living mites were present on the fruits two and three weeks after treatment. The active stages of the mite were killed by all treatments.

In field tests, maximum dosages of 10 gm. Neotran or parathion per 1,000 cu. ft. were released by means of the applicator under tents over lemon trees not exceeding 1,800 cu. ft. in volume, lemons infested with all stages of the mite being hung in the trees before treatment. Exposure was for 45 minutes. The aerosols had little or no effect on the eggs, and living mites of all stages were present 1, 5 and 21 days after treatments. When lemon trees heavily infested with all stages of the mite were treated under fumigation tents with HCN (20 cc. schedule) alone or with the aerosols, no living mites were found on leaf samples three days later, but a heavy population of all stages developed in 20 days. The combined treatments were no better than HCN alone. Other tests showed that fumigation with HCN prevents many eggs from hatching and sometimes gives a high kill of mites, but enough eggs hatch to permit a rapid increase in population.

It appears that the distribution of aerosols under tent-covered trees is not adequate for effective control of *P. citri*. Many outside leaves and fruits are in contact with the tent, and the outer foliage, on which the mite population is usually heavy, is compressed by the weight of the tent, so that it is difficult to obtain a deposit of the acaricide where it is most needed.

WALKER (R. L.), FIFE (L. C.) & BONDY (F. F.). **Dusting-schedule Experiments with Toxaphene for Boll Weevil Control.**—*J. econ. Ent.* **43** no. 6 pp. 946–947. Menasha, Wis., 1950.

Experiments on the timing of insecticidal applications against *Anthonomus grandis* Boh. on cotton were carried out in 1948 and 1949 at Florence, South Carolina. Aphids and mites were not numerous enough to influence yields. A 20 per cent. toxaphene dust was applied three times weekly beginning when squares began to appear or a week later, with or without four additional applications beginning when 10 per cent. of the squares were infested, or three times at 5-day intervals, beginning at 10 per cent. infestation, with or without 1–4 additional applications, beginning when infestation again reached 10 per cent. and ceasing when the plants matured. Yields increased after three applications, regardless of the schedules used, the increases averaging about 135 lb. seed cotton per acre for each application. Additional applications caused an average increase of about 50 lb. per acre per application.

CUTRIGHT (C. R.). **New Insecticides for Summer Control of Apple Flea Weevil.**—*J. econ. Ent.* **43** no. 6 p. 947, 3 refs. Menasha, Wis., 1950.

Rhynchaenus (*Orchestes*) *pallicornis* (Say) (apple flea-weevil) is usually controlled in orchards in Ohio by spraying with fluorine compounds in early spring [*cf. R.A.E.*, A **24** 91, 714], but serious infestations occasionally develop during the summer. In a test of some of the newer insecticides against a heavy summer infestation, sprays of 0·75 or 1·5 lb. EPN (27 per cent. ethyl p-nitrophenyl thionobenzenephosphonate), 1 or 2 lb. 15 per cent. parathion, 2 lb. 50 per cent. methoxy-DDT (methoxychlor) or 2 lb. 50 per cent. DDT per 100 U.S. gals. on single trees on 12th July gave complete control in a week or less, whereas 5 lb. cryolite per 100 U.S. gals. did not. Excellent results were also obtained when a large block of trees was sprayed with 50 per cent. DDT wettable powder.

WENE (G. P.). **Sunflower Moth Larva injuring young** *Citrus*.—*J. econ. Ent.* **43** no. 6 p. 948. Menasha, Wis., 1950.

In April 1950, larvae of the sunflower moth, *Homoeosoma electellum* (Hulst), were observed attacking new growth on young *Citrus* trees in Texas. The trees were two years old and had been severely pruned after a hard frost in January 1949, and the new growth was about 5–6 inches long. The larvae killed this by boring in the lower halves of the twigs and had attacked about half the young growth in the grove. This had recently been cultivated, so that it was free from weeds, but it was evident that wild sunflowers had been growing in it in the past. In an adjacent grove that had not been cultivated and contained many heavily infested wild sunflowers, no *Citrus* trees were attacked by the larvae. The moth evidently preferred sunflower for oviposition but would deposit eggs on the new growth of young *Citrus* if sunflower was not available. Dusting with 5 per cent. DDT at 30 lb. per acre from an aeroplane eliminated the insect from the infested grove.

DRIGGERS (B. F.). **Parathion toxic to Codling Moth Larvae after they enter the Fruit.**—*J. econ. Ent.* **43** no. 6 pp. 948–949, 2 refs. Menasha, Wis., 1950.

Additional information was obtained in New Jersey in 1950 on the effect of parathion on young larvae of the codling moth [*Cydia pomonella* (L.)] a few days after they have entered apples [*cf. R.A.E.*, A **39** 113]. A petal-fall and two cover sprays of 1·5, 1 and 1 lb. 15 per cent. parathion wettable powder

per 100 U.S. gals were applied to the trees, the last of them on 18th–22nd June, and on 5th July it was observed that apples were being attacked again. On 9th July, a spray of 1 lb. 15 per cent. parathion per 100 U.S. gals. was applied to some of the trees from the east side only. Two days later, recently stung apples were collected from the sprayed and unsprayed sides of these trees and from others that had not received the last spray. Dissection and rearing studies showed that no larvae matured in apples from either side of the sprayed trees, indicating a fumigant action, as compared with 30 from 47 apples from unsprayed ones.

On 11th July, fresh signs of attack were observed on apple trees interplanted with peaches. A sample of apples was collected, the trees were sprayed all round with 1 lb. 25 per cent. parathion wettable powder per 100 U.S. gals., and further fruit samples were taken two days and one week later. No larvae were reared from the sprayed apples, and 55 from 75 unsprayed ones. In both tests, most of the larvae appeared to be 1–5 days old at the time of spraying and had not begun tunnelling to the core.

Rosenstiel (R. G.). **Reactions of Two-spotted Mite and Predator Populations to Acaricides.**—*J. econ. Ent.* **43** no. 6 pp. 949–950, 2 figs. Menasha, Wis., 1950.

An outbreak of the two-spotted mite [*Tetranychus bimaculatus* Harvey] occurred on red raspberries in the northern Willamette Valley of Oregon in August 1949, and preliminary experiments were undertaken on its control. Sprays of dinitro-o-cyclohexylphenol, parathion and di(p-chlorophenyl) methylcarbinol and dusts of TEPP (tetraethyl pyrophosphate) and parathion were applied on 3rd August, when natural mortality was low. All materials except the dinitro compound gave significant kills in four days and reduced the numbers of eggs considerably by 11th August. On 14th September, nearly half the mites in the untreated plot were dead, and this mortality was equalled only in the carbinol plot. There had been a steady decline of mites in the untreated plot after 11th August and an increase in the parathion plot from 7th August to a peak on 2nd September. Field observations showed that the larvae and adults of *Stethorus punctum* (Lec.) were feeding on all stages of the mites and their eggs and appeared to be giving important control.

Sprays of β-chloroethyl-β-(p-tert.-butylphenoxy)-α-methylethyl sulphite (88-R) and parathion were applied on other plots on 16th August. Larvae of *S. punctum* had disappeared on the parathion plot by 20th August, but reappeared a month after treatment. They were reduced in numbers on the sulphite plot and numerous on untreated plots. Parathion was effective in controlling the mite, and the sulphite in egg reduction and initial reduction of the adults.

It is concluded that further tests are desirable to find acaricides that do not interfere with natural control by predators.

Rawlins (W. A.) & Newhall (A. G.). **An improved Method of applying Insecticides for Onion Maggot Control.**—*J. econ. Ent.* **43** no. 6 pp. 950–951. Menasha, Wis., 1950.

Small but serious outbreaks of *Hylemyia antiqua* (Mg.) that occur each year on onions in New York tend to be overlooked until too late because of their sporadic nature, and attempts were therefore made to combine preventive treatment against them with the fungicidal treatment applied at the time of sowing. A small rotary duster mounted on a three-row sower was used to apply a mixture of 20 per cent. fungicide (tetramethyl thiuramdisulphide) and 80 per cent. of a wettable powder containing 25 per cent. dieldrin [1, 2, 3, 4, 10, 10-hexachloro-6, 7-epoxy-1, 4, 4a, 5, 6, 7, 8, 8a-octahydro-1, 4, 5, 8-diendomethanonaphthalene] to two rows at the rate of 20–25 lb. per acre, and

seed coated with the fungicide was sown in the third row. Infestation by *H. antiqua* killed 83·6 per cent. of the plants in the row sown with coated seeds but damaged only 3 per cent. in the two rows treated with dieldrin, and corresponding results were obtained in a lighter infestation.

Later in the season, plots near the heavily infested site were treated as before with a mixture containing 20 per cent. fungicide and 20 per cent. actual insecticide against the second generation of *Hylemyia*. The numbers of eggs round ten plants in the untreated rows and those receiving dieldrin and heptachlor [1 (or 3a), 4, 5, 6, 7, 8, 8-heptachloro-3a, 4, 7, 7a-tetrahydro-4, 7-endomethanoindene] were 71, 103 and 47, respectively, and the percentages of plants injured 90, 4 and 3 ; 29 per cent. were injured in plots treated with aldrin [1, 2, 3, 4, 10, 10–hexachloro-1, 4, 4a, 5, 8, 8a-hexahydro-1, 4, 5, 8-diendomethanonaphthalene], which appeared to be less effective than the other materials, though this result is not considered conclusive. It appeared that the insecticides did not discourage oviposition, but killed the young larvae before they could penetrate the plants. Further tests are necessary to ascertain the quantity of insecticide needed for adequate control and the effect of various materials on the germination, growth and flavour of the crop.

McGregor (E. A.). **The taxonomic Status of certain Tetranychid Mites of the United States and Europe.**—*J. econ. Ent.* **43** no. 6 pp. 951–952, 1 fig. Menasha, Wis., 1950.

The author compared *Tetranychus bimaculatus* Harvey, the so-called common spider mite of the United States, from the type locality in Maine, with lime-tree mites [*T. tiliarius* (Herm.)] and hollyhock mites [*T. telarius* (L.)] from Europe identified by European workers as *T. telarius* and *T. althaeae* v. Hanst., respectively. He concludes that *T. tiliarius* is very distinct from the other two in the structure of the aedeagus and that *T. bimaculatus* differs in certain details of the aedeagus and the palp-tarsus of the female from *T. telarius*, which is probably its nearest ally in Europe [*cf. R.A.E.*, A **30** 600 ; **39** 102]. Various other Tetranychids from the United States and elsewhere possess aedeagi somewhat resembling those of *T. telarius* and *T. bimaculatus*, but it is possible to separate them when other taxonomic characters are considered. The aedeagi of this latter group are illustrated in a figure.

Hurtig (H.) & Perry (A. S.). **Slide Coatings for Aerosol Droplet Collection and Preservation.**—*J. econ. Ent.* **43** no. 6 pp. 952–954, 2 figs., 6 refs. Menasha, Wis., 1950.

Descriptions are given of methods of collecting and preserving aerosol droplets on slides for subsequent examination in their original spherical shape. They are based on collection of the drops in a matrix in which they are insoluble. Preliminary tests were carried out by coating a slide with magnesium oxide by passing it repeatedly over a flame from burning magnesium ribbon until there was a layer thicker than the largest droplet anticipated ; droplets hitting the surface penetrated it and left a round permanent hole. Droplets of volatile substances left permanent records, regardless of subsequent evaporation, but the minimum droplet size at which the diameter of the hole was a true replica of the droplet diameter was 30–40 microns, and other techniques were therefore investigated for use with aerosols.

For both water and oil aerosols, the slide coating should be of a density similar to that of the liquid atomised, higher viscosity and different refractive index. The droplets should remain discrete, without agglomeration, and the coating should be stiff enough not to run on vertical slides and soft enough not to impede complete submergence of the droplets in the matrix ; the latter

was particularly important for aerosols, to prevent evaporation of the collected samples. A certain amount of rigidity was required when whole slides were to be exposed vertically in wind-tunnel studies and in slides cut for use in sampling aerosols with the cascade impactor.

A mixture of heavy mineral oil and vaseline (3 : 1) was successfully employed for water-aerosol sampling ; slides examined up to two weeks after collection showed no evidence of change of droplet size or shape. The most satisfactory results for the common phytonomic spray oils in aerosols were obtained with a mixture of 40 ml. each of water and glycerin, 10 ml. each of triethanolamine and oleic acid and 3 gm. gelatin. This mixture can be prepared in quantity beforehand, but should be warmed before use to liquefy it. The coatings remain viscous enough for the slides to be used vertically, and do not set too quickly. After the samples are obtained, fine glass capillaries or pieces of coverslips are coated with enough of the matrix to cover the sample and carefully applied so that the droplets are drawn up as spheres. The glass fragments ensure sufficient space for the droplets to assume their spherical shape completely surrounded by the matrix with no distortion. Unless the droplets are covered by a complete liquid film in this manner, those that do not penetrate the matrix at the time of sampling sometimes form thin circular films or lenses that give the erroneous appearance of spheres. In field work, it was sometimes advisable to omit the gelatin from the slide coating, but not from that on the coverslip. After the matrix has set, the samples can be subjected to rough treatment and prolonged storage, so long as the temperature is kept below 25°C. [77°F.].

Although this formula was satisfactory for most oils or oil solutions of insecticides such as DDT and pyrethrins, some difficulty was encountered in sampling aerosols of chlordan in fuel oil or methylated-naphthalene solvents, since these were soluble in the oleic acid, with a consequent slight decrease in the size of the trapped aerosol droplets before the matrix set. The substitution of liquid soap, saponin and certain commercial emulsifying and wetting agents for the oleic acid obviated this.

Bronson (T. E.) & Dudley jr. (J. E.). **Pea Aphid Control with Sprays applied by a Mist Blower.**—*J. econ. Ent.* **43** no. 6 pp. 954–955, 1 fig. Menasha, Wis., 1950.

The authors describe a mist blower tested in 1949 for applying concentrated sprays against the pea Aphid [*Macrosiphum onobrychis* (Boy.)] in Wisconsin. The air blast is generated by a 30-in. radial fan to deliver approximately 3,500 cu. ft. per minute at a velocity of 5,500 ft. per minute. It is directed through a large sheet-metal duct and discharged through four tubes 6 ins. in diameter spaced along the duct. The tubes have fishtail outlets 2·25 by 24 ins. in size, which are directed backwards and downwards at an angle of 45°, distributing the spray uniformly over a swathe 20 ft. wide. Two spray nozzles are mounted just inside the opening of each of the four outlets, the insecticide is forced through copper tubing to these at a pressure of 75–100 lb. per sq. in., and the rate of application can be varied from 5 to 15 or more U.S. gals. per acre. The apparatus is drawn by a tractor, usually at a speed of 3·5 miles per hour.

During the summer, 30 formulations, in which the principal toxicants were DDT, TEPP (tetraethyl pyrophosphate) and parathion, were applied to peas, usually at 8 U.S. gals. per acre, and infestation and foliage injury were recorded 5–8 days later. Parathion gave the best control, a wettable powder being as effective as an emulsion and a dosage of 0·156 lb. per acre not appreciably more effective than 0·078 lb. TEPP as a solution was effective at a dosage of 0·28 lb. per acre, but not at 0·14 lb., which permitted the Aphid population to increase again after 3–4 days. An emulsified solution of DDT in xylene at

0·25 or 0·5 lb. DDT per acre had a slower killing action, but compared favourably with the other materials in the later counts. A mixture of 0·25 lb. DDT and 0·14 lb. TEPP per acre in xylene emulsion gave excellent control, since the TEPP caused a high initial kill and DDT provided prolonged action.

In plots treated with DDT, slight discoloration of the foliage appeared in 1–2 days but disappeared shortly thereafter ; it was believed to be due to the striking of the tender leaves by the air-driven spray. TEPP caused brown spotting of the foliage, particularly on the lower leaves, which increased with the dosage applied. Foliage injury due to parathion was most evident in the growing tips. The suspension caused sunken areas, which did not appear important, and the emulsions browning of the tissue, which may have caused some damage to the crop.

Michelbacher (A. E.), Middlekauff (W. W.) & Hanson (C.). **Occurrence of a Fungus Disease in overwintering Stages of the Codling Moth.**—*J. econ. Ent.* **43** no. 6 pp. 955–956, 1 fig., 1 ref. Menasha, Wis., 1950.

During investigations on overwintering larvae of *Cydia* (*Carpocapsa*) *pomonella* (L.) under the bark of walnut trees in California in 1945, it was observed that some had been killed by one or more entomogenous fungi ; surveys indicated that 4·25 per cent. had been killed by 7th March and 27 per cent. by 21st March. Three similar surveys were made in 1950 and showed that 78 of 200, 120 of 200 and 137 of 171 larvae examined on 15th and 29th March and 10th April, respectively, and also 0, 3 and 3 of 24, 28 and 29 pupae, had been killed by fungi. The larvae were more subject to attack in damp situations, and mortality was higher on the north than on the south side of the trunks. The principal fungus present was identified as being closely related to *Beauveria bassiana*. It is concluded that fungi are important natural enemies of *C. pomonella* under certain conditions.

Doutt (R. L.). **The Suitability of Insect-conditioned Plant Tissues as Habitats for successive Insect Species.**—*Pan-Pacif. Ent.* **24** no. 3 pp. 121–122. San Francisco, Calif., 1948.

In April 1947, large numbers of *Platypedia* sp. were present in an apple orchard in California, and oviposition scars of this Cicadid were abundant on the apple twigs on 9th May. On 22nd May, migrating immature forms of *Eriosoma lanigerum* (Hsm.) were observed settling on the scars, and many of the colonies so formed persisted throughout the summer, despite predacious Coccinellids and Syrphids. The scars also provided overwintering sites from which the Aphids could disperse in spring.

During observations on parasites of *Gnorimoschema baccharisella* Busck, which forms galls on the stems of *Baccharis pilularis consanguinea*, crawlers of *Saissetia oleae* (Bern.) were observed to enter the galls by the exit holes made by the emerging moths and settle on their inside walls. Here they are frequently attended by *Iridomyrmex humilis* (Mayr) and are protected from natural enemies by the ants and the inaccessibility of their feeding site. L. R. Gillogly has recorded a species of *Pseudococcus* developing and ovipositing within galls caused by other insects on *Baccharis*.

DeLong (D. M.). **Two new Species of *Neokolla* closely related to *gothica* (Homoptera : Cicadellidae).**—*Pan-Pacif. Ent.* **24** no. 3 pp. 141–144, 3 figs. San Francisco, Calif., 1948.

Descriptions are given of the adults of both sexes of *Neokolla gothica* (Sign.) from the eastern United States, *N. severini*, sp. n., from California and Arizona,

and *N. aridella*, sp. n., from Arizona and Mexico. *N. gothica* is the common eastern form, and its range extends west of the Mississippi, probably to the Rocky Mountains in some States, but *N. severini*, which has long been confused with it, is the common species on the west coast and the one that Severin has found to be a vector of the virus of lucerne dwarf and Pierce's disease of grapevine [*cf. R.A.E.*, A **33** 172].

DOUTT (R. L.). *Arrenoclavus*, **a new Genus of polyembryonic Encyrtidae (Hymenoptera).**—*Pan-Pacif. Ent.* **24** no. 3 pp. 145–148, 2 figs., 3 refs. San Francisco, Calif., 1948.

Arrenoclavus, gen. n., is erected for the polyembryonic Encyrtid, *Copidosoma koehleri* Blanch. ; the species was included in a key but not formally described by Blanchard [*R.A.E.*, A **29** 344]. Descriptions of the adults of both sexes are given, together with briefer ones of the egg, polygerm and sexual and asexual larvae.

MICHELBACHER (A. E.), MIDDLEKAUFF (W. W.) & HANSON (C.). **A Report on Results of Investigations in northern California during 1949, for Tomato Insect Control.**—*Agric. Chem.* **5** no. 6 pp. 30–31, 95, 97–98, 3 refs. Baltimore, Md., 1950.

Investigations in 1946–48 showed that DDT, DDD [dichlorodiphenyldichloroethane] and toxaphene gave effective control of caterpillars attacking tomatos grown for canning without causing excessive residues [*cf. R.A.E.*, A **38** 287], and by 1949, most of the tomatos grown in northern California were treated with DDT or DDD, with the result that injury to fruit was practically eliminated in that year, although the season was more favourable than usual for a number of important caterpillar pests of tomato, and particularly for the armyworm, *Prodenia praefica* Grote. DDD was used more that DDT as it is more effective against *Protoparce sexta* (Joh.), particularly in the warmer interior valleys where this Sphingid threatens serious damage.

The populations of several pests, including *Liriomyza* (*Agromyza*) *subpusilla* (Frost) [**34** 57], *Estigmene acraea* (Dru.) and an unidentified Tetranychid, generally considered unimportant on tomato, increased to a level at which they caused concern in 1948. The first was the only one that was widely distributed ; it was abundant in most fields late in the season and caused considerable defoliation by mining the leaves, but was not destructive except where this occurred early in the summer and there was consequently serious loss of fruit due to sunburn. In 1949, investigations were carried out at two places to determine whether the widespread use of DDD and DDT was associated with these outbreaks.

In the first, dust applications on 13th July, 15th August and 12th September of 10 per cent. toxaphene with 40 per cent. sulphur or a mixture of 5 per cent. toxaphene and 3 per cent. DDT with 50 per cent. sulphur reduced the percentages of fruits infested by caterpillars from 16·24 to 0·88 and 0·66 at the first picking and from 11·49 to 0 at the second. Applications of 5 per cent. DDT or DDD with 50 per cent. sulphur on the first two dates and without it on the third reduced them to 0·99 and 0·66 at the first picking and to 0 and 2 at the second. In the second test, applications of the first two dusts on 11th–12th July, 12th–13th August and 14th September reduced the percentages from 12·75 to 1·32 and 0·55 at the first picking, from 11·25 to 0·99 and 0 at the second and from 7 to 1 and 0·5 at the third. Applications of 5 per cent. DDD with 50 per cent. sulphur on the first two dates and without it on the third reduced the percentages to 0·22, 0·33 and 0·25 at the three pickings, respectively. The control plants were dusted with sulphur on 18th–20th July in

both tests. *L. subpusilla* was present in both areas, and its seasonal population trends were followed on all plots. It appeared to be as abundant on untreated as on treated ones, but did not reach destructive numbers. There was some evidence that 10 per cent. toxaphene gave some control, but it would not have been enough to check a severe infestation. Environmental factors were apparently much more important in regulating the abundance of the leafminer than any of the insecticides used, but the ecological factors favouring infestation were not ascertained. Other observations confirmed that when environmental conditions are favourable, infestation by the leafminer may be severe without the application of DDT or DDD. There appeared to be time for it to pass through at least five generations between the beginning of July and the end of the season. It was in general extremely rare until late August, after which it increased rapidly, and the populations were largest during late September and early October. Late in the season, plants in good foliage were more heavily infested than less vigorous ones, but little damage seems likely to occur unless the miner is well established in tomato fields by late August.

It is concluded that excellent control of tomato pests should result from the use of 5 per cent. DDT or DDD dusts applied at 30 lb. per acre against caterpillars, with at least 50 per cent. sulphur to control *Vasates* (*Phyllocoptes*) *destructor* (Keifer). The toxaphene dusts should be applied at the same rates but require further commercial testing. The first application should be made between 1st and 15th July, primarily against *Vasates*, the second between 1st and 20th August, primarily against *Protoparce* and armyworms, and the third between 1st and 20th September, primarily against the corn earworm [*Heliothis armigera* (Hb.)], other cutworms, the tomato pinworm [*Keiferia lycopersicella* (Busck)] and the potato tuber moth [*Gnorimoschema operculella* (Zell.)]. In the central and southern San Joaquin Valley, applications should be begun as early as late May or June and continued as long as there is evidence of damage.

Steinhaus (E. A.) & Hughes (K. M.). **Two newly described Species of Microsporidia from the Potato Tuberworm,** *Gnorimoschema operculella* **(Zeller) (Lepidoptera, Gelechiidae).**—*J. Parasit.* **35** no. 1 pp. 67–75, 1 pl., 2 figs., 11 refs. Lancaster, Pa., 1949.

Laboratory cultures of *Macrocentrus ancylivorus* Rohw. and *Gnorimoschema operculella* (Zell.) in California were found in 1946 to be infected with a microsporidian, possibly the one recorded from *M. ancylivorus* in 1945 [*R.A.E.*, A **34** 314] and subsequently reported from both host and parasite and referred to the genus *Nosema*. Production of *G. operculella* was reduced by nearly 50 per cent. and that of *M. ancylivorus* by 65–70 per cent. Studies begun in 1947, however, showed that in addition to *Nosema*, *G. operculella* was also infected by a species of *Plistophora*, and the two are here described as *N. destructor* and *P. californica*, spp. n., respectively. Observations on their life-cycles are recorded.

Neither produces any distinctive symptoms in the larvae of *Gnorimoschema*, which become sluggish and feed less and, when infected by *N. destructor*, sometimes become stunted and die, though they usually give rise to infected adults ; heavily infected larvae sometimes appear whitish in colour. Both protozoa occur in almost any tissues of the host, but are commonest in the fat-body and Malphigian tubes and, in the case of *N. destructor*, the silk glands. A suspension of spores of *N. destructor* in water produced infection in almost 100 per cent. of test larvae after being kept at 4°C. [39·2°F.] for 87 days and in 50 per cent. after 184 days ; spores kept as dry smears on glass slides were still infective after 38, but not after 168, days. The percentage of leucocytes in the blood of larvae infected by *N. destructor* was reduced from 67 to 40 and that of lymphocytes was increased from 33 to 60. In experiments by oral administration on the host range of the two organisms, both infected larvae of *Cydia*

(*Carpocapsa*) *pomonella* (L.), *Colias eurytheme* Boisd., *Phryganidia californica* Pack., *Danaus plexippus* L., *Macrocentrus ancylivorus*, *Perisierola emigrata* Rohw. and *Cremastus flavoorbitalis* (Cam.). *Nosema* also infected *Laphygma exigua* (Hb.) and *Pieris rapae* (L.), and *Plistophora* also *Vanessa carye* Hb., *Arrenoclavus* (*Copidosoma*) *koehleri* (Blanch.) and *Chrysopa californica* Coq. Larvae of *Tenebrio molitor* L. and *Estigmene acraea* (Dru.) did not become infected by either species. Eggs laid by females of *G. operculella* infected by *Nosema* were freed from infection by immersion in water at 47°C. [116·6°F.] for 20 minutes, with no loss of viability, but similar treatment for up to 90 minutes gave little or no reduction of larvae infected by *Plistophora* [*cf.* **38** 433, 434].

Robb (J.). **The seasonal Incidence of the Codling Moth** (*Cydia pomonella* **L.**) **in the Manawatu.**—*N.Z. J. Sci. Tech.* **31** (A) no. 5 pp. 15–22, 9 figs., 2 refs. Wellington, N.Z., 1951.

The seasonal cycle of *Cydia pomonella* (L.) on apple in the Manawatu district of New Zealand was investigated during 1947–48 and the early part of 1948–49 to provide a basis for timing spray applications for control. The observations were made in an orchard that had been sprayed regularly against *C. pomonella* and one that had not been sprayed for at least two years. Tins containing 1 quart of a mixture of 3 oz. compressed yeast, 1½ pints molasses and 19 pints water were hung in the trees to trap the adults, and corrugated cardboard bands were placed round the trunks to attract larvae migrating from the fruits. Moths, which were already present when the observations were begun on 30th November 1947, were trapped intermittently until late February 1948 and the main spring emergence continued until about 19th December ; observations in October and November 1948 indicated a similar trend, emergence beginning in late October. Migrating larvae were first taken on 29th December 1947 in both orchards ; the fruit in the sprayed orchard was harvested in March, but in the unsprayed orchard migration continued until 5th May 1948 and reached its peak late in March. Of 1,813 larvae taken in the bands and kept in cages during 1947–48, 4·36 per cent. gave rise to adults during the same summer ; most of these emerged in late January and early February. The data from the trap bands also indicated the existence of at least a partial second generation.

On the basis of these results, it is suggested that the first spray against *C. pomonella* should be applied in early November, or 8–10 days after moderate numbers of moths are caught in bait-traps.

Lloyd (N. C.). **The Cherry Aphid** (*Myzus cerasi* **Fab.**) **in the Orange District.**—*Agric. Gaz. N.S.W.* **61** pts. 2–3 pp. 83–86, 149–152, 4 figs., 3 refs. Sydney, 1950.

The standard treatment for application to cherry in New South Wales against *Myzus cerasi* (F.), the life-history of which is reviewed [*R.A.E.*, A **24** 598], is a dormant ovicidal spray of tar distillate (1 : 40), supplemented or replaced by later sprays of nicotine sulphate and soap [**25** 587]. Since this has not been entirely satisfactory, experiments on the use of DDT and HETP (hexaethyl tetraphosphate) were begun. Various preparations of DDT were used at concentrations giving 0·1 per cent. p,p′DDT, and the HETP was used at 1 : 1,600 with a neutral wetting agent.

In tests in November 1947, when the trees were heavily infested and many leaves were curled, DDT gave satisfactory control and prevented reinfestation for 3–4 weeks when used as a dispersible wax [*cf.* **36** 179] or an emulsified solution in solvent naphtha, with a wetting agent, but did not penetrate the leaves enough when used as a dispersible powder or a mayonnaise-type emulsion.

HETP gave rapid mortality, but did not prevent reinfestation by migrating alates. In 1948, emulsified solutions of DDT in solvent naphtha with a wetting agent or in toluene, used with and without lime-sulphur, and HETP applied to moderately infested trees on 25th October, just after sepal fall, all gave reasonable penetration of the curled leaves and did not damage the trees. Infestation was greatly reduced by the predacious Coccinellids, *Coccinella repanda* Thnb. and *Leis conformis* (Boisd.), soon after application, but examination of leaf-clusters not affected by these 24 hours after spraying showed that most of the Aphids on the trees sprayed with HETP and about 30 per cent. of those on the trees sprayed with DDT were dead ; maximum mortality on the latter was not reached for at least a week. The toxicity of the DDT was not affected by the addition of lime-sulphur. The DDT sprays gave complete protection against *Caliroa limacina* (Retz.) [*cf.* **37** 43], as did DDT applied in another orchard on 12th November. HETP gave rapid Aphid control but is considered to be less useful than DDT because it has no lasting effect, cannot be combined with lime-sulphur and is not likely to give satisfactory control of *C. limacina.*

Tests were also carried out in 1948 to ascertain whether DDT could be used to destroy the newly hatched Aphids at the bud-swell or pinking stage as an alternative to the dormant spray of tar distillate, which is unpleasant to apply. A spray of 4 per cent. p,p′DDT in pale oil diluted 1 : 40 and combined with bordeaux mixture (6 : 6 : 40) was applied on 13th September, when a few buds had already burst. DDT in mayonnaise-type emulsion also combined with the bordeaux mixture was applied on 21st September at the open-cluster stage, and a tar distillate (1 in 40) was applied on 5th August, when the trees were completely dormant. These treatments were all equally effective, and, although infestation was very light, reduced the subsequent number of infested leaf-clusters per tree from 11–25 to 1½–2. The DDT sprays gave good coverage, were relatively pleasant to apply, and did not injure the buds. DDT in pale oil applied by growers during the same season did not give consistently good results, however, and further investigations are needed before it can be recommended.

On the basis of these tests, DDT as an emulsified solution or HETP, both at the concentrations tested, are recommended as alternatives to the standard treatments. They can be applied at the late bud-swell, green-tip or early pinking stages, at sepal-fall, or when the trees are in leaf, or, if early applications do not give satisfactory control, at more than one of these stages. DDT is preferable for the later applications owing to its toxicity to *C. limacina*, but should not be used within three weeks of ripening. Cherry suckers and seedlings, on which small numbers of Aphids remain during the hot weather, should be either sprayed or destroyed.

May (A. W. S.). **The Cotton Jassid Problem in Queensland.**—*Qd J. agric. Sci.* **7** no. 1–2 pp. 24–42, 3 figs., 17 refs. Brisbane, 1950.

Damage to cotton by Jassids has increased of recent years in Queensland and threatens to limit cultivation of the crop in some areas, and investigations were accordingly begun there in 1941. The Jassids found breeding on cotton were *Empoasca maculata* Evans, which proved to be the important species, *E. terrae-reginae* Paoli, to which much of the damage had previously been attributed, and *E. alfalfae* Evans, which caused little injury. The observations showed that *E. maculata* restricts its activity to the terminal growth of the cotton, so that its increase occurs when growing conditions for the plants are favourable. The eggs are deposited in the leaves of growing terminal shoots and in partly opened leaves, usually in the lower surface of the larger leaf-veins, and sometimes in the petioles and stems. The oviposition

punctures become apparent soon after the leaves open and are most numerous on the third and fourth leaves below the growing point. The nymphs usually complete their development on the leaves in which they hatched, and there may be as many as 30 on one leaf. The adults occur on any part of the plant, but are most frequent near the growing point. Both nymphs and adults feed on the veins on the lower surface of the leaves. The growing points of the main stem and the vegetative branches provide more favourable conditions than those of the fruiting and extra-axillary branches. Adults kept in glass tubes survived for only 24 hours without food, but for as long as 12 days when supplied with fresh cotton leaves.

E. maculata appears on newly planted cotton early in the season, but attempts to find its winter food-plant were unsuccessful. It did not occur in winter on ratoon cotton, which is scarce, and early infestation occurs in the absence of both ratoon and standover cotton, as well as on newly cleared land where cotton has not previously been cultivated. Adults were found in winter on *Clerodendron tomentosum* in one place, but no breeding took place on it, and it was not infested in subsequent years, when cotton was not grown in the neighbourhood. Of the four other plants on which *E. maculata* occurred in summer when they were growing among or near cotton, two are annuals and the other two unsuitable for overwintering populations. The food-plant range of seven Jassids found during the survey is shown in an appendix.

The development of infestation by *E. maculata* in spring depends largely on the availability of cotton in a suitable condition of growth. Early spring rains may enable high populations to build up on young September-planted crops, but the relatively short, hot, dry periods of early summer and mid-summer check plant growth, and the Jassid rarely becomes important before early square formation and may never do so. Where regular summer storms occur, however, populations build up steadily and reach a peak during the period of rapid plant growth associated, especially in late planted crops or late maturing varieties, with late summer rains. The resultant injury and the relatively dry, cool autumn weather provide unfavourable conditions, and populations decrease at rates dependent on the intensity of these factors. Isolated individuals may persist until the frosts.

As a result of nymphal feeding, the leaves show a partial wilting that is usually temporary, their margins curl downwards, the tissues near the punctures become chlorotic, and they usually eventually turn red and fall ; they rarely become necrotic. Adult feeding and oviposition cause the veins to split and become necrotic, and the leaf tips to curl downwards, and where curling due to both nymphal and adult feeding occurs, the leaves are severely buckled and brittle. Resistant varieties are damaged only where they are near heavily infested susceptible ones, and only by adult feeding. There is some evidence that only fully expanded leaves are shed and that those that curl extensively persist after less severely damaged ones have fallen. Since relatively few nymphs can produce these symptoms, it is probable that the Jassids inject a toxin into the leaves.

Although large adult populations cause severe leaf injury and stunting in seedlings, damage in early planted crops is rarely noticeable before the first bolls are set. Heavy infestation and slower plant growth following increased boll formation may later arrest the growth of the plants and highly susceptible ones may be completely stunted. When growth is restricted, square formation is reduced, the flowers occur nearer to the ends of the fruiting branches, and some squares are shed. Where it ceases, the undeveloped squares remain crowded and are eventually shed. Profitable yields, especially from late-planted crops, are not likely once growth has been suppressed ; bottom and middle crops may be formed on early-planted cotton before Jassid populations

build up, but if they are destroyed by *Heliothis armigera* (Hb.) the large Jassid populations that develop on the resultant vegetative growth will probably prevent any further crop development. Bolls formed during intense Jassid activity are usually shed, and those formed prior to it may either develop slowly and not open fully, or shrivel. Yields of seed cotton are materially reduced by infestation, especially on late-planted crops or where cropping coincides with high mid-summer Jassid populations. In an experiment, irrigated cotton was more severely damaged than rain-grown cotton planted about a month earlier on the same soil.

Infestation by *E. terrae-reginae* is usually appreciable only on young cotton during spring and early summer, when the normal food-plant (tomato) is not available. Both nymphs and adults feed on any part of the plant and are therefore less injurious than *E. maculata*. The latter is usually fairly evenly dispersed throughout the field, but *E. terrae-reginae* penetrates only slowly beyond the point of entry, where it may check growth to some extent. Populations rarely increase on cotton. Nymphs sometimes occur on the lower surface of the terminal leaves ; older leaves that have been heavily infested by adults become pale in colour. *E. alfalfae* was found on cotton in two places, in one of which infestation resulted from forced migration from neighbouring leguminous plants and only occasional leaves were damaged. The injury comprises the development of pale green chlorotic areas near the margin of the terminal leaves and some curling of the leaf margins.

Since most cotton crops in Queensland depend on rainfall and since losses due to *H. armigera* may greatly exceed those due to the Jassid, costly control measures cannot be employed against the latter. Sprays or dusts of DDT are effective [*R.A.E.*, A **35** 243] and may be economic on irrigated crops on which other pests need to be controlled. Early planting is desirable, but weather conditions are not always favourable. The best measure appears to be the use of early-maturing varieties of cotton, which often escape damage, and of resistant varieties.

Papers noticed by Title only.

Brandt (H.). **Die Verbreitung der San José-Schildlaus in Italien.** [The Distribution of the San José Scale in Italy (a review from the literature).] —*Anz. Schädlingsk.* **21** pt. 7 pp. 103–107, 4 figs., 5 refs. Berlin, 1948.

Satterthwait (A. F.). **A Supplement to " Key to known Pupae of the Genus** *Calendra* [*Sphenophorus*], **with Host-plant and Distribution Notes ".**— *Ann. ent. Soc. Amer.* **41** no. 3 pp. 369–370, 1 ref. Columbus, Ohio, 1948. [*Cf. R.A.E.*, A **19** 318.]

Bavendamm (W.). **Die Prüfung der natürlichen Dauerhaftigkeit des Holzes, insbesondere des Tropenholzes, gegen Pilze, Termiten und Bohrmuscheln.** [Tests of the natural Resistance of Wood, particularly tropical Wood, to Fungi, Termites and marine Borers (a review from the literature).] —*Z. Weltforstw.* **12** pt. 7–9 pp. 137–144, 113 refs. Hamburg, 1948. (With Summaries in English and French.)

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FOREST PRODUCTS RESEARCH BOARD (LONDON): Report for the period ended 30th September, 1928.
FORÊT QUÉBECOISE (QUEBEC): Vols. 1 (1939) Nos. 1, 4, 6, 10; 2 (1940) Nos. 1, 3, 6.
GAMBIA: Medical and Sanitary Reports 1939–42.
GEORGIA STATE BOARD OF ENTOMOLOGY (ATLANTA, GA.): Bulletins 2, 6, 22 and 28; Circulars 1–3, 12, 15–18 and 20.
GOLD COAST DEPARTMENT OF AGRICULTURE: Bulletin 25 (1932).
HARVARD FOREST BULLETIN (PETERSHAM, MASS.): No. 5 (1922).
HONG KONG. BOTANICAL AND FORESTRY DEPARTMENT: Reports for 1928 & 1939.
INDIA. FOREST RESEARCH INSTITUTE (DEHRA DUN): Forest Bulletin (Old Series) Nos. 1–3.
INDIA. IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH (DELHI): Annual Report for 1939–40.
INDIAN CENTRAL JUTE COMMITTEE. AGRICULTURAL RESEARCH LABORATORY (CALCUTTA): Annual Report 1941–42.
INDIAN LAC RESEARCH INSTITUTE (NAMKUM): Report for 1942–43.
INDIAN MEDICAL GAZETTE (CALCUTTA): Vols. 50 (1915) No. 10; 51 (1916) Nos. 1–7, 10; 52 (1917) No. 7 and title-page & index; 53 (1918); 54 (1919) No. 2; 76 (1941) title-page & index; 77 (1942) No. 8; 78 (1943) Nos. 1 & 10; 81 (1946) title-page & index.
INSEKTO INTERESA (NANTUNG): Vols. 1 (1935) Nos. 1, 4 to end; 2 (1936) No. 5 to end.
IZVESTIYA UZBEKISTANSKOGO FILIALA AKADEMIĬ NAUK SSSR (TASHKENT): 1940 No. 9.
JAMAICA. DEPARTMENT OF AGRICULTURE (KINGSTON): Bulletin 31 (1941); Annual Report 1903–04, 1907–08, 1909–10, 1911–12.
JOURNAL OF AGRICULTURAL RESEARCH (WASHINGTON, D.C.): Vols. 59 (1939) Nos. 4, 5, 11, 12; 61 (1941) No. 3.
JOURNAL OF THE BOARD OF AGRICULTURE OF BRITISH GUIANA (DEMERARA): Vol. 3 (1909) No. 1; title-pages & indices to vols. 1–2.
JOURNAL OF THE SOUTH-EASTERN AGRICULTURAL COLLEGE (WYE, KENT): Nos. 1–6, 8 (1895–99).
KENYA AND EAST AFRICAN MEDICAL JOURNAL (NAIROBI): Vol. 2 (1925) Nos. 2–3.
KONOWIA (VIENNA): Bd. 17 (1939) Heft 2–3.
KRANKE PFLANZE, DIE (DRESDEN): Jahrg. 16 (1939) Nos. 9–12; 17 (1940); 18 (1941); 21 (1944) Nos. 3–8, 10–12.
MARTUINOV (A. B.). WINGS OF TERMITES AND PHYLOGENY OF ISOPTERA AND OF ALLIED GROUPS OF INSECTS.—TRAV. INST. (? LAB.) EVOL. MORPH. ACAD. SCI. URSS (LENINGRAD): Tome à l'honneur de N. V. Nasonov, pp. 83–150, 1937.
MEDICAL PARASITOLOGY AND PARASITIC DISEASES (MOSCOW): Vols. 1 (1932) No. 1; 11 (1943) Nos. 1–3; 12–13 (1943–44); 14 (1945) Nos. 5–6; 15 (1946) Nos. 1–3.
MEZÖGAZDASÁGI KUTATÁSOK (BUDAPEST): Vol. 2 (1929) No. 7–8.
MITTEILUNGEN DER GESELLSCHAFT FÜR VORRATSSCHUTZ (BERLIN): Jahrg. 16 (1940) Hefte 1 & 5; 17 (1941).
MITTEILUNGEN DER MÜNCHNER ENTOMOLOGISCHEN GESELLSCHAFT (MUNICH): Bd. 34 (1944) Heft 2 (1948) and index.
NATUURHISTORISCH MAANDBLAD (MAASTRICHT): Jaarg. 1 (1912); 2 (1913) Nos. 1–4, 6–9; 5 (1916) Nos. 3–4; 7 (1918) Nos. 6–9; 8 (1919) No. 4.
NAUCHNUIE ZAPISKI PO SAKHARNOĬ PROMUISHLENNOSTI. AGRONOMICHESKIĬ VUIPUSK (KIEV): God 14 (1937) vuip. 4–6; 15 (1938) vuip 5–6.
NEW JERSEY STATE DEPARTMENT OF AGRICULTURE (TRENTON, N. J.): Circulars 2, 12, 29 (1917–19).
NEW YORK STATE MUSEUM (ALBANY, N.Y.): Bulletin 57 (1902).
NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION (RALEIGH): 38th (1914–15), 49th (1925–26), 51st (1927–28), 52nd (1928–29) Reports.
NORTHERN RHODESIA. VETERINARY DEPARTMENT: Report for 1940.
ONTARIO ENTOMOLOGICAL SOCIETY (TORONTO): 9th Report (1878).
ORMEROD (E. A.). OBSERVATIONS OF INJURIOUS INSECTS AND COMMON FARM PESTS DURING THE YEARS 1877 & 1878 (London, 1878–79).
PENSÉE MÉDICALE D'USBÉQUISTANE ET DE TURQUMÉNISTANE (TASHKENT): Vol. 5 (ix-x) (1931) Nos. 1–3, 5 to end.

LIBRARY LACUNAE—*cont.*

PERU. MINISTERIO DE AGRICULTURA. ESTACIÓN EXPERIMENTAL AGRÍCOLA DE LA MOLINA (LIMA) : Informe 56 (1943) ; Boletín 24 (1943) ; Circular 61 (1943).
PESTS AND THEIR CONTROL (KANSAS CITY, MO.) : Vol. 15 (1947) Nos. 7–8.
PHILIPPINE AGRICULTURIST (LAGUNA) : Vol. 30 (1941) No. 9.
PHILIPPINE JOURNAL OF AGRICULTURE (MANILA) : Vols. 9 (1938) No. 3 ; 10 (1939) No. 3 ; 11 (1940) Nos. 1–3 & index ; 12 (1941) No. 3 & index.
PHILIPPINE JOURNAL OF SCIENCE (MANILA) : Vols. 72 (1940) No. 4 ; 76 (? 1941) No. 2.
PORTO RICO DEPARTMENT OF AGRICULTURE, &c. (SAN JUAN) : Journal, Vol. 1 (1917) No. 3.
PORTO RICO REVIEW OF PUBLIC HEALTH AND TROPICAL MEDICINE (SAN JUAN) : Vols. 1 ; 2 ; 3 (1928) Nos. 1–8, 12.
PROCEEDINGS. CALIFORNIA MOSQUITO CONTROL ASSOCIATION (BERKELEY) : 14th annual conference 1945.
PROCEEDINGS. OHIO STATE HORTICULTURAL SOCIETY (COLUMBUS, OHIO) : Vol. 79 (1946).
PSYCHE (BOSTON, MASS.) : Vols. 11 (1904), 13 (1906), 16 (1909).
PUBLIC HEALTH REPORTS (WASHINGTON, D.C.) : Vol. 55 (1940) No. 52.
PUBLICACIÓN. DIVISIÓN DE MALARIOLOGÍA, MINISTERIO DE SANIDAD Y ASISTENCIA SOCIAL (CARACAS) : No. 4 (1939).
PUNJAB DEPARTMENT OF AGRICULTURE (LAHORE) : Reports for 1938–41.
REPORT OF THE COMMISSION APPOINTED TO INVESTIGATE THE MOTH BORER AND OTHER DISEASES. Barbados, 1894.
REVISTA DE LA ACADEMIA COLOMBIANA DE CIENCIAS EXACTAS, FÍSICAS Y NATURALES (BOGOTÁ) : Nos. 1–8 (1938–39).
REVISTA DE AGRICULTURA DE PUERTO RICO (SAN JUAN) : Vol. 2 (1919) No. 6 ; indices to vols. 6–16.
REVISTA CHILENA DE HISTORIA NATURAL (SANTIAGO) : Año 15 (1911) No. 3 to end ; 16, 18, 26 (1912, 1914, 1922).
REVISTA FACULTAD NACIONAL DE AGRONOMÍA, COLOMBIA (MEDELLÍN) : No. 1 (1939).
REVISTA DE PARASITOLOGÍA, CLÍNICA, Y LABORATORIO (later) REVISTA DE MEDICINA TROPICAL Y PARASITOLOGÍA, BACTERIOLOGÍA, CLÍNICA Y LABORATORIO (HAVANA) : Vols. 1 (1935) No. 1 ; 2 (1936) Nos. 1–3 ; 3 (1937) 4 (1938) ; Nos. 1–2.
REVISTA DE SANIDAD Y ASISTENCIA SOCIAL (CARACAS) : Vol. 13 (1948) No. 5–6.
REVISTA DE SANIDAD E HIGIENE PÚBLICA (MADRID) : Vol. 22 (1948) Nos. 1 & 3 ; 23 (1949) No. 5 ; 24 (1950) No. 1.

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